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MCB CAMP LEJEUNE
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FINAL SITE SPECIFIC WORK PLAN ADDENDUM FOR INTRUSIVE INVESTIGATION FOR MILITARY MUNITIONS RESPONSE PROGRAM SITES UXO-01, UXO-02, UXO-07, UXO-11, UXO-17, UXO-21 MCB CAMP LEJEUNE NC

9/1/2011

CH2M HILL

Final

Site-specific Work Plan Addendum for Intrusive Investigation for Military Munitions Response Program Sites:

UXO-01 – Former Live Hand Grenade Course (ASR #2.23)
UXO-01 - Former Gas Chamber (ASR #2.79a, b, c),
UXO-02 - Former Unnamed Explosive Contaminated Range (ASR #2.201)
UXO-07 – Former Practice Hand Grenade Course (ASR #2.77a and #2.77b),
UXO-11 - Former B-5 Practice Hand Grenade Course (ASR #2.81),
UXO-14 - Former Indoor Pistol Range (ASR #2.199) and
Former Gas Chamber (ASR #2.200)
UXO-17 - Former Firing Position 2 (ASR #2.12)
UXO-21 - Former D-Area Gas Chamber (2D MAR DIV) (ASR #2.204)

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order WE41

September 2011

Prepared for

Department of the Navy
Naval Facilities Engineering Command

Under the

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

Prepared by

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Acronyms and Abbreviations

AEC	area of environmental concern
AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
ASR	Archive Search Report
BERA	Baseline Ecological Risk Assessment
bgs	below ground surface
BHC	benzene hexachloride
BIP	blow-in-place
BMP	best management practice
C/D	class/division
CA	chemical agent
CAMA	Coastal Area Management Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CN	chloroacetophenone
CS	o-chlorobenzylidenemalonitrile
CTO	Contract Task Order
CVOC	chlorinated volatile organic compound
CWM	chemical warfare materiel
DCE	dichloroethene
DD Form 1348	Requisition System Document
DDESB	Department of Defense Explosives Safety Board
DDT	dichlorodiphenyltrichloroethane
DFOW	definable feature of work
DGM	digital geophysical mapping
DMM	discarded military munitions
DoD	Department of Defense
DPT	direct push technology
DU	decision unit
ECBC	Edgewood Chemical Biological Center
EOD	Explosive Ordnance Disposal
ERA	Ecological Risk Assessment
ERS	ecological risk screening
ESQD	explosives safety quantity-distance
ESS	Explosives Safety Submission
ESV	ecological screening value
EZ	exclusion zone

ft/day	feet per day
ft^2/day	square feet per day
ft/ft	feet per foot
FTL	Field Team Leader
GPS	global positioning system
H&S	health and safety
HE	high explosive
HHRS	human health risk screening
HQ	hazard quotient
IAS	Initial Assessment Study
IBD	inhabited building distance
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
INRMP	Integrated Natural Resources Management Plan
IR	Installation Restoration
lb	pound, pounds
LUC	land use control
m	meter
mm	millimeter
MARCORSYSCOM	Marine Corps System Command
MC	munitions constituents
MCB CamLej	Marine Corps Base Camp Lejeune
MCE	maximum credible event
MDAS	material documented as safe
MEC	munitions and explosives of concern
MGFD	munition with the greatest fragmentation distance
MILCON	military construction
MMRP	Military Munitions Response Program
MPP	Master Project Plan
MPPEH	material potentially presenting an explosive hazard
MRP	Munitions Response Program
MRS	Munitions Response Site
MS/MSD	matrix spike/matrix spike duplicate
MSD	minimum separation distance
msl	mean sea level
NAVFAC	Naval Facilities Engineering Command, Mid-Atlantic
NCDENR	North Carolina Department of Environment and Natural Resources
NOSSA	Naval Ordnance Safety and Security Activity
ORR	Operations Readiness Review
OU	operable unit
oz	ounce

PA/SI	Preliminary Assessment/Site Investigation
PCB	polychlorinated biphenyl
PETN	pentaerythritol tetranitrate
PM	Project Manager
POC	point of contact
POIA	Post Office Intersection Area
PTR	public transportation route
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCP	Quality Control Plan
RSL	Regional Screening Level
RTK	real-time kinematic
SAP	Sampling and Analysis Plan
SLERA	screening level risk assessment
SOP	standard operating procedure
SSHSP	Site Specific Health and Safety Plan
SVOC	semivolatile organic compound
SUXOS	Senior Unexploded Ordnance Supervisor
TAL	target analyte list
TCE	trichloroethene
TCL	Target Compound List
TSD	team separation distance
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
VC	vinyl chloride
VOC	volatile organic compound
WMP	Waste Management Plan
WQP	water quality parameter
WWII	World War II

SECTION 1

Introduction

Under the Military Munitions Response Program (MMRP) and pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Marine Corps Base Camp Lejeune (MCB CamLej) is in the process of addressing munitions and explosives of concern (MEC) and munitions constituents (MC) at ranges that are not operational. MCB CamLej has conducted Preliminary Assessments/Site Inspections (PA/SIs), the first phase of the remedial process, for the eight listed MMRP sites. Based on the results of the associated digital geophysical mapping and environmental sampling, expanded SIs were needed at these sites to assess remaining explosive and chemical-related risks to human and ecological receptors.

1.1 Background and Project Objectives

MCB CamLej is conducting expanded SIs at eight Military Munitions Response Sites (MRSs):

- UXO-01 – Former Live Hand Grenade Course (Archive Search Report [ASR] #2.23)
- UXO-01 – Former Gas Chamber (ASR #2.79a, b, and c)
- UXO-02 – Former Unnamed Explosive Contaminated Range (ASR #2.201)
- UXO-07 – Former Practice Hand Grenade Course (ASR #2.77a and #2.77b)
- UXO-11 – Former B-5 Former Practice Hand Grenade Course (ASR #2.81)
- UXO-17 – Former Firing Position 2 (ASR #2.12)
- UXO-14 – Former Indoor Pistol Range (ASR#2.199) and Former Gas Chamber (ASR #2.200)
- UXO-21 – Former D-Area Gas Chamber (2D MAR DIV) (ASR #2.204)

The locations of these sites are shown on **Figure 1-1**.

This investigation is being conducted under the Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000 Program, Contract N62470-08-D-1000 Contract Task Order (CTO) WE41.

The primary project objective is to assess the nature of geophysical anomalies that may represent potential subsurface MEC within the eight listed MMRP sites. A secondary objective is to further assess human health and ecological risks at sites where analytical results indicate potential risk to these populations. This Work Plan identifies the activities that will be performed to accomplish these objectives.

1.2 Work Plan Scope and Organization

The following activities will be performed at each site in accordance with methods and procedures detailed in the MCB CamLej Munitions Response Program (MRP) Master Project Plan (MPP) (CH2M HILL, 2008a):

- Reacquire all of geophysical anomalies identified as representing potential subsurface MEC for which intrusive investigations have not been previously conducted

- Execute manual digging and identification of the sources of the selected anomalies
- Perform demilitarization of all MEC and material identified during the intrusive activity as potentially presenting an explosive hazard (MPPEH)
- Conduct environmental sampling for MC at locations where controlled detonations are conducted
- Perform anomaly removal verification and excavation backfilling
- Transport material documented as safe (MDAS) offsite for processing
- Collect and analyze environmental samples to evaluate potential risks to human and/or ecological receptors identified in previous investigations.
- Prepare After Action Reports for each site where it is determined that all munitions response actions are complete to document the MEC intrusive investigation.
- Prepare expanded SI reports summarizing the results from intrusive investigations, sampling events, and ecological and Human Health Risk Screenings (HHRSs), and recommending future actions.

This Work Plan is divided into sections providing information on the detailed approach including procedures to be employed during the execution of the project. Appendixes to the Work Plan provide supporting documentation that details specific procedures for the execution of the project.

This Work Plan is organized as follows:

- **Section 1, Introduction,** provides general information about this Work Plan, describes the eight MMRP sites, summarizes the history and previous investigations at each site, and presents the project scope and objectives.
- **Section 2, Technical Management Plan,** identifies the technical approach, methods, and operational procedures that will be implemented during the intrusive investigation.
- **Section 3, Field Investigation Plan,** identifies the technical approach, methods, and operational procedures that will be implemented during the field investigation activities, including surface soil sampling where controlled detonations are conducted.
- **Section 4, MEC Intrusive Investigation Plan,** identifies the technical approach, methods, and operational procedures that will be implemented during the MEC intrusive investigation, including disposal of non-MEC and non-MPPEH anomaly source material, and demilitarization of MEC and MPPEH (if required).
- **Section 5**, **Explosives Management Plan,** provides details for management of explosives in accordance with applicable regulations.
- **Section 6, Explosives Siting Plan,** provides explosives safety criteria for planning and siting explosives operations.

- **Section 7, Quality Control Plan (QCP),** provides details of the approach, methods, and operational procedures to be employed for quality control (QC) of the intrusive investigation support activities at the MMRP sites.
- **Section 8, Environmental Protection Plan,** describes the approach, methods, and operational procedures to be employed to protect the natural environment during the performance of all tasks at the MMRP sites.
- **Sections 9 through 16 present site specific descriptions, histories, summaries of past investigations, and field sampling and MEC intrusive investigation objectives and designs as follows:**
  - **Section 9, UXO-01 Former Live Hand Grenade Course (ASR #2.23)**
  - **Section 10, UXO-01 Former Gas Chamber (ASR #2.79a, b, and c)**
  - **Section 11, UXO-02 Former Unnamed Explosive Contaminated Range (ASR #2.201)**
  - **Section 12, UXO-07 Former Practice Hand Grenade Course (ASR #2.77a and 2.77b)**
  - **Section 13, UXO-11 Former B-5 Practice Hand Grenade Course (ASR #2.23)**
  - **Section 14, UXO-14 Former Indoor Pistol Range (ASR #2.199) and Gas Chamber (ASR #2.200)**
  - **Section 15, UXO-17 Former Firing Position 2 (ASR #2.12)**
  - **Section 16, UXO-21 Former D-Area Gas Chamber (2D MAR DIV) (ASR #2.204)**
- **Section 17, References,** lists the references cited in the preceding sections.
- **Appendix A, Site-specific Health and Safety Plan (SSHSP),** the SSHSP comprises the health and safety (H&S) policy and procedures for work performed by CH2M HILL and its subcontractors for work at the subject MMRP sites. The SSHSP is used in conjunction with the Accident Prevention Plan (APP) in the MR MPP (CH2M HILL, 2008a).
- **Appendix B, Uniform Federal Policy (UFP)-Sampling and Analysis Plan (SAP) for Site UXO-02 and UXO-14 and UFP-SAP for UXO-11 and UXO-17** references project management/ project planning aspects, measurement data acquisitions, assessment oversight, and data review processes used to carry out environmental characterization sampling tasks of this Work Plan. Two UFP-SAPs are provided in Appendix B, one for Sites UXO-02 and UXO-14 and another for Sites UXO-11 and UXO-17. These UFP-SAPs meet the requirements of Step 4 of the USEPA 8-step Ecological Risk Assessment (ERA) process, therefore a separate Baseline Ecological Risk Assessment (BERA) Work Plan is not required.
- **Appendix C, UFP-SAP Cross-walk Table, Quality Assurance Project Plan (QAPP),** references project management/ project planning aspects, measurement data acquisitions, assessment oversight, and data review processes used to carry out tasks of this Work Plan for Sites UXO-01 (ASR #2.23), UXO-01 (ASR #2.79a, b, and c), UXO-07, and UXO-21.

- **Appendix D, MEC Removal Standard Operating Procedures (SOPs),** provides standard operating procedures detailing MEC removal procedures.
- **Appendix E, Forms,** provides daily operating and QC forms, as well as checklists for QC inspections.
- **Appendix F, Step 3b Evaluation of Site 69 Surface Soil and Sediment.** Appendix F contains Step 3b of the USEPA ERA 8-step process that applies to Site UXO-02. Step 3b (problem formulation development) considered: the relationship between site pesticide concentrations and background, the distribution of pesticides, source of pesticides found at the site, fate and transport, exposure factors used in the Screening-level Ecological Risk Assessment (SLERA), and the appropriateness of the screening-level ecological benchmarks used in the SLERA. The Step 3b evaluation forms the basis for surface soil and sediment sampling rationales for Site UXO-02.

1.3 Site Descriptions and Histories

A description of MCB CamLej and its history discussed in Section 1.4 of the MRP MPP (CH2M HILL, 2008a). Site-specific information is provided in **Sections 9** though **16.**

1.4 Climate

The climate in the MCB CamLej area is discussed in Section 1.4 of the MRP MPP (CH2M HILL, 2008a).

1.5 Geology and Hydrogeology

The regional geology and hydrogeology at MCB CamLej is discussed in Section 1.6 and 1.7 of the MRP MPP (CH2M HILL, 2008a).

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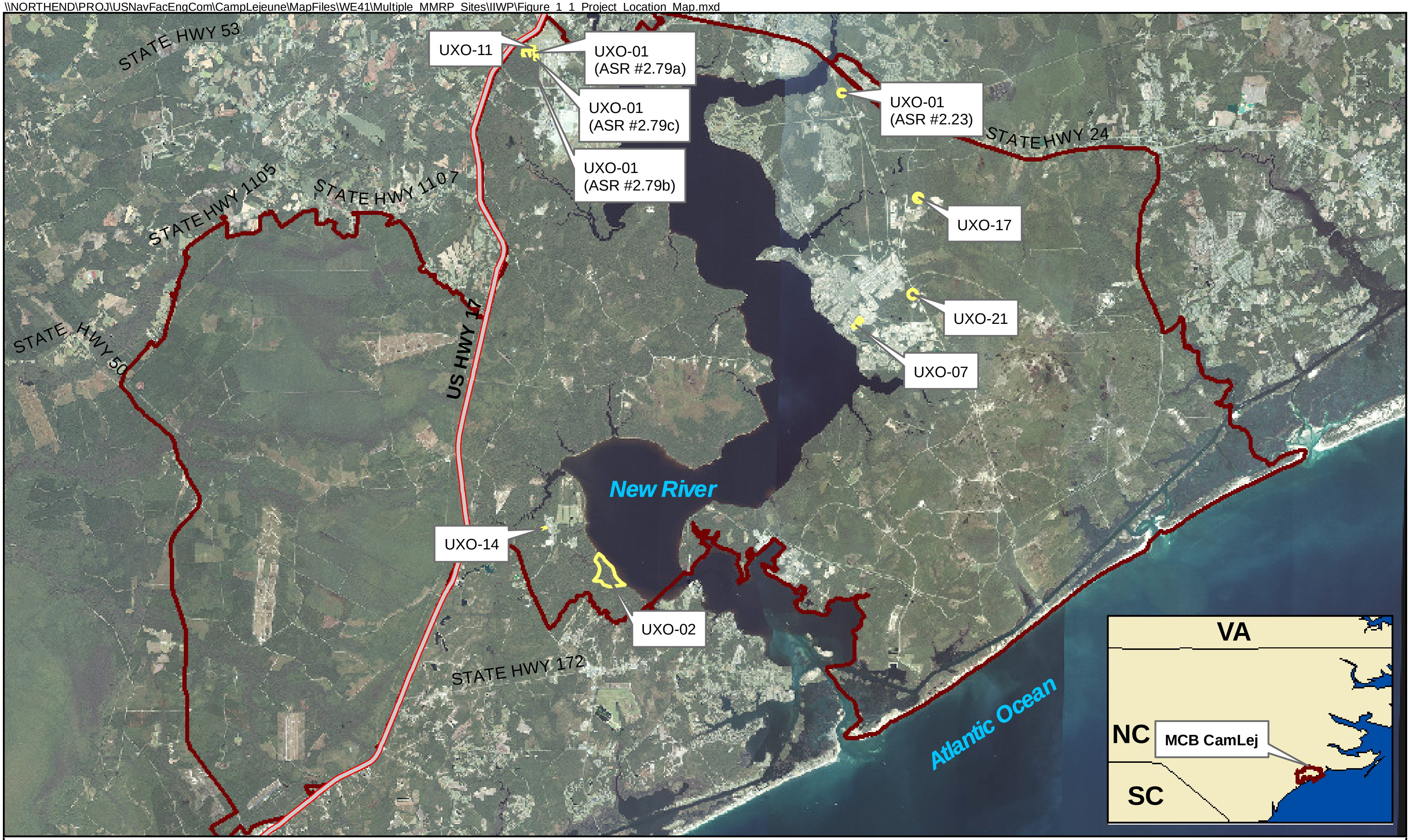

Legend
- Munitions Response Site Boundaries
- Highways
- Installation Boundary

N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1-1
Site Location Map
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

SECTION 2

Technical Management Plan

2.1 Guidance, Regulations, and Policies

The MRP intrusive investigation at the eight subject MRSs will be conducted under the guidance documents, regulations, and polices described in **Section 2.1** of the MRP MPP (CH2M HILL, 2008a).

2.2 Explosives Safety Submissions

Base-wide and site-specific Explosives Safety Submissions (ESSs) have been submitted for review by Marine Corps System Command (MARCORSYSCOM) and Department of Defense Explosives Safety Board (DDESB). The ESSs will conform to all applicable Marine Corps, Department of the Navy, and Department of Defense (DoD) requirements for the safe handling of MEC and explosives. Intrusive investigation activities will not be conducted until ESS approval is received. Site-specific information is provided in **Sections 9** though **16.**

2.3 MEC Contingency Procedures

Based on the documented history of DoD activities at Sites UXO-01 (ASR#2.23), UXO-01 (ASR#2.79 a, b, and c), UXO-02, UXO-07, UXO-11, UXO-17, and UXO-21, it is anticipated that if MEC is discovered it can be destroyed onsite. If MEC is discovered at Site UXO-14, Base Explosive Ordnance Disposal (EOD) will be contacted for disposal. MEC is not anticipated at UXO-14, which only has a history of small arms use and potential historical tear gas use. Alternatives to onsite disposal are not identified in this Work Plan. Likewise, the discovery of MEC that cannot be identified is not anticipated. If any MEC items are discovered that cannot be identified, MEC contingency procedures will be conducted in accordance with Section 2.2 of the MRP MPP (CH2M HILL, 2008a).

2.4 Chemical Warfare Materiel Contingency Procedures

Based on the documented history of DoD activities at the subject MRSs, it is not anticipated that chemical warfare materiel (CWM) will be discovered. No activity is anticipated to be performed inside Site 69 within UXO-02, the only area with suspected CWM. If CWM is encountered, all work will immediately cease and CWM contingency procedures will be conducted in accordance to Section 2.3 of the MRP MPP (CH2M HILL, 2008a).

2.5 Project Organization, Personnel, Reporting, and Schedule

2.5.1 Project Organization

The key organizations involved in this project are Naval Facilities Engineering Command, Mid-Atlantic (NAVFAC), MCB CamLej, the North Carolina Department of Environment and Natural Resources (NCDENR), USEPA, and CH2M HILL. Project execution will be

conducted by CH2M HILL and its subcontractors; specific duties for CH2M HILL and its subcontractors are described in Section 2.4 of the MRP MPP (CH2M HILL, 2008a).
CH2M HILL will issue a subcontract for vegetation clearance, MEC intrusive investigation, demolition, and disposal, direct push technology (DPT) drilling, survey, laboratory analysis, data validation, and investigation-derived waste (IDW) disposal.

2.5.2 Project Personnel

The reporting relationship between key project personnel and the roles and responsibilities of the key personnel are discussed in Section 2.4 of the MRP MPP (CH2M HILL, 2008a). Contact information for key project personnel is shown in **Table 2-1**.

2.5.3 Project Schedule

Figure 2-1 presents a detailed project schedule, including key milestones.

2.6 Technical Approach

2.6.1 Task 1—Project Planning

This task includes project management, meetings, Work Plan preparation, UFP-SAP preparation (Sites UXO-02 and Site UXO-14 are addressed in one UFP-SAP; Site UXO-11and UXO-17 are addressed in a second SAP), QAPP preparation, and subcontractor procurement.

Project management includes all work necessary for controlling the project budget and schedule. This includes monthly status reports and invoicing, as well as all other administrative tasks needed for project performance.

Meetings are planned throughout the course of this project. The meetings will be held to discuss proposed work, present investigation findings, and discuss project status. The meetings are planned to be held at MCB CamLej, or at other locations as necessary.

Subcontractor procurement is also included under this task. Anticipated subcontractor services include vegetation clearance, MEC intrusive investigation, demolition, and disposal, DPT drilling, survey, laboratory analysis, data validation, and IDW disposal.

2.6.2 Task 2—MEC Intrusive Investigation

A MEC intrusive investigation will be conducted to investigate geophysical anomalies identified during the PA/SI activities. The digital geophysical mapping (DGM) results are shown on:

- **Figure 9-2** (Site UXO-01 [ASR#2.23]**)**
- **Figure 10-2** (Site UXO-01 [ASR #2.79a, b, and c])
- **Figure 11-4** (Site UXO-02)
- **Figure 12-2** (Site UXO-07)
- **Figure 13-2** (Site UXO-11)
- **Figure 14-2** (Site UXO-14)
- **Figure 15-2** (Site UXO-17)
- **Figure 16-2** (Site UXO-21)

The primary field activities at each site are the following:

- Mobilization/site preparation
- Anomaly reacquisition/detection
- Manual excavation
- Anomaly identification and verification
- MEC/MPPEH demolition (if necessary)
- Post Detonation sampling to detect potential MC presence(if necessary)
- MDAS disposal
- IDW Disposal
- Site restoration/demobilization

2.6.3 Task 3—Environmental Sampling

At specific sites environmental characterization sampling may be performed. Surface and subsurface soil, sediment, surface water, and groundwater may be collected to confirm previous analytical results or to further assess the nature and extent of contamination. Site-specific sampling designs and analytes are provided in **Sections 9** though **16**, as applicable.

2.6.4 Task 4—Reporting

An After Action Report will be prepared for each MRS where it is determined that all munitions response actions are complete. After Action Reports will be prepared in accordance with Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15C (NOSSA, 2011) to document the results of the MEC intrusive investigations. The reports will provide a summary of all MEC found during the investigation, summarize all the MEC removal activities, and provide evaluation of the selected removal methods and relative effectiveness.

An Expanded SI Report will also be prepared for each MRS. The Expanded SI Reports will include descriptions of the intrusive investigation, results from sampling events, ecological and human health screening results, discussion of the final disposition of all wastes, and recommendations.

TABLE 2-1
Project Personnel Contact Information
Intrusive Investigation Work Plan Addendum
Sites UXO-01 (ASR#2.23), UXO-01(ASR#2.79a,b,c), UXO-7, UXO-11, UXO-14, and UXO-21
MCB CamLej
Jacksonville, North Carolina

Name/Title/Organization	Mailing Address	Telephone/Fax/E-mail
Phil Smith Program Manager CH2M HILL	5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757- 671-8311(office) 757-497-6885(fax) Philip.Smith@ch2m.com
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Tim Garretson MEC Integrator/Senior MEC Technical Consultant CH2M HILL	9428 Baymeadows Road Suite 300 Jacksonville, FL 32256	904- 374-5633 (office) 757- 287-5222 (cell) timothy.garretson@ch2m.com
George DeMetropolis, PhD Corporate MR Safety and QC Officer CH2M HILL	CH2M HILL 402 W. Broadway, Suite 1450 San Diego, CA 92101	619-687-0120, Ext. 37239 (office) 619-564-9627 (cell) George.DeMetropolis@ch2m.com

ID	Task Name	Duration	Start	Finish
1	**Expanded SI at MMRP Sites - UXO-01 (ASR#2.23) , UXO-01 (ASR#2.79a,b,c) , UXO-07 (ASR#2.77a & 2.77b), UXO-11 (ASR#2.281), UXO-21 (ASR#2.204), UXO-17, UXO-14, UXO-02**	**200 days**	**Thu 6/9/11**	**Thu 3/15/12**
2	**Work Plan**	**33 days**	**Thu 6/9/11**	**Tue 7/26/11**
3	Submit Work Plan - Draft	15 days	Thu 6/9/11	Wed 6/29/11
4	Client Review	2 days	Thu 6/30/11	Fri 7/1/11
5	Work Plan - Revised Draft Final	1 day	Tue 7/5/11	Tue 7/5/11
6	Regulatory Review	10 days	Wed 7/6/11	Tue 7/19/11
7	Work Plan - Final	5 days	Wed 7/20/11	Tue 7/26/11
8	**Investigation/Reporting**	**181 days**	**Thu 7/7/11**	**Thu 3/15/12**
9	**UXO-11**	**181 days**	**Thu 7/7/11**	**Thu 3/15/12**
10	Site Preparation/Environmental Sampling	18 days	Thu 7/7/11	Mon 8/1/11
11	Data Processing	25 days	Tue 8/2/11	Mon 9/5/11
12	Anomaly Investigation	1 day	Tue 8/2/11	Tue 8/2/11
13	Expanded SI Report	89 days	Wed 8/3/11	Mon 12/5/11
14	After Action Report	73 days	Tue 12/6/11	Thu 3/15/12
15	**UXO-17**	**180 days**	**Fri 7/8/11**	**Thu 3/15/12**
16	Site Preparation/Environmental Sampling	13 days	Fri 7/8/11	Tue 7/26/11
17	Data Processing	31 days	Wed 7/27/11	Wed 9/7/11
18	Vegetation Clearance, Anomaly Investigation	13 days	Wed 7/13/11	Fri 7/29/11
19	Expanded SI Report	78 days	Mon 8/1/11	Wed 11/16/11
20	After Action Report	86 days	Thu 11/17/11	Thu 3/15/12
21	**UXO-14**	**180 days**	**Fri 7/8/11**	**Thu 3/15/12**
22	Site Preparation/Environmental Sampling	7 days	Fri 7/8/11	Mon 7/18/11
23	Data Processing	31 days	Tue 7/19/11	Tue 8/30/11
24	Vegetation Clearance, Anomaly Investigation	6 days	Tue 7/19/11	Tue 7/26/11
25	Expanded SI Report	75 days	Wed 7/27/11	Tue 11/8/11
26	After Action Report	92 days	Wed 11/9/11	Thu 3/15/12
27	**UXO-02**	**180 days**	**Fri 7/8/11**	**Thu 3/15/12**
28	Site Preparation/Environmental Sampling	16 days	Fri 7/8/11	Fri 7/29/11
29	Data Processing	31 days	Mon 8/1/11	Mon 9/12/11
30	Vegetation Clearance, Anomaly Investigation	23 days	Tue 7/26/11	Thu 8/25/11
31	Expanded SI Report	61 days	Fri 8/26/11	Fri 11/18/11
32	After Action Report	84 days	Mon 11/21/11	Thu 3/15/12
33	**UXO-07**	**162 days**	**Wed 8/3/11**	**Thu 3/15/12**
34	Anomaly Investigation	5 days	Wed 8/3/11	Tue 8/9/11
35	Expanded SI Report	73 days	Wed 8/10/11	Fri 11/18/11
36	After Action Report	84 days	Mon 11/21/11	Thu 3/15/12
37	**UXO-01 (ASR#2.23)**	**171 days**	**Thu 7/21/11**	**Thu 3/15/12**
38	Vegetation Clearance, Anomaly Investigation	15 days	Thu 7/21/11	Wed 8/10/11
39	Expanded SI Report	69 days	Thu 8/11/11	Tue 11/15/11
40	After Action Report	87 days	Wed 11/16/11	Thu 3/15/12
41	**UXO-01 (ASR#2.79a,b,c)**	**172 days**	**Wed 7/20/11**	**Thu 3/15/12**
42	Vegetation Clearance, Anomaly Investigation	7 days	Wed 7/20/11	Thu 7/28/11
43	Expanded SI Report	78 days	Fri 7/29/11	Tue 11/15/11
44	After Action Report	87 days	Wed 11/16/11	Thu 3/15/12
45	**UXO-21**	**170 days**	**Fri 7/22/11**	**Thu 3/15/12**
46	Vegetation Clearance, Anomaly Investigation	18 days	Fri 7/22/11	Tue 8/16/11
47	Expanded SI Report	69 days	Wed 8/17/11	Mon 11/21/11
48	After Action Report	83 days	Tue 11/22/11	Thu 3/15/12

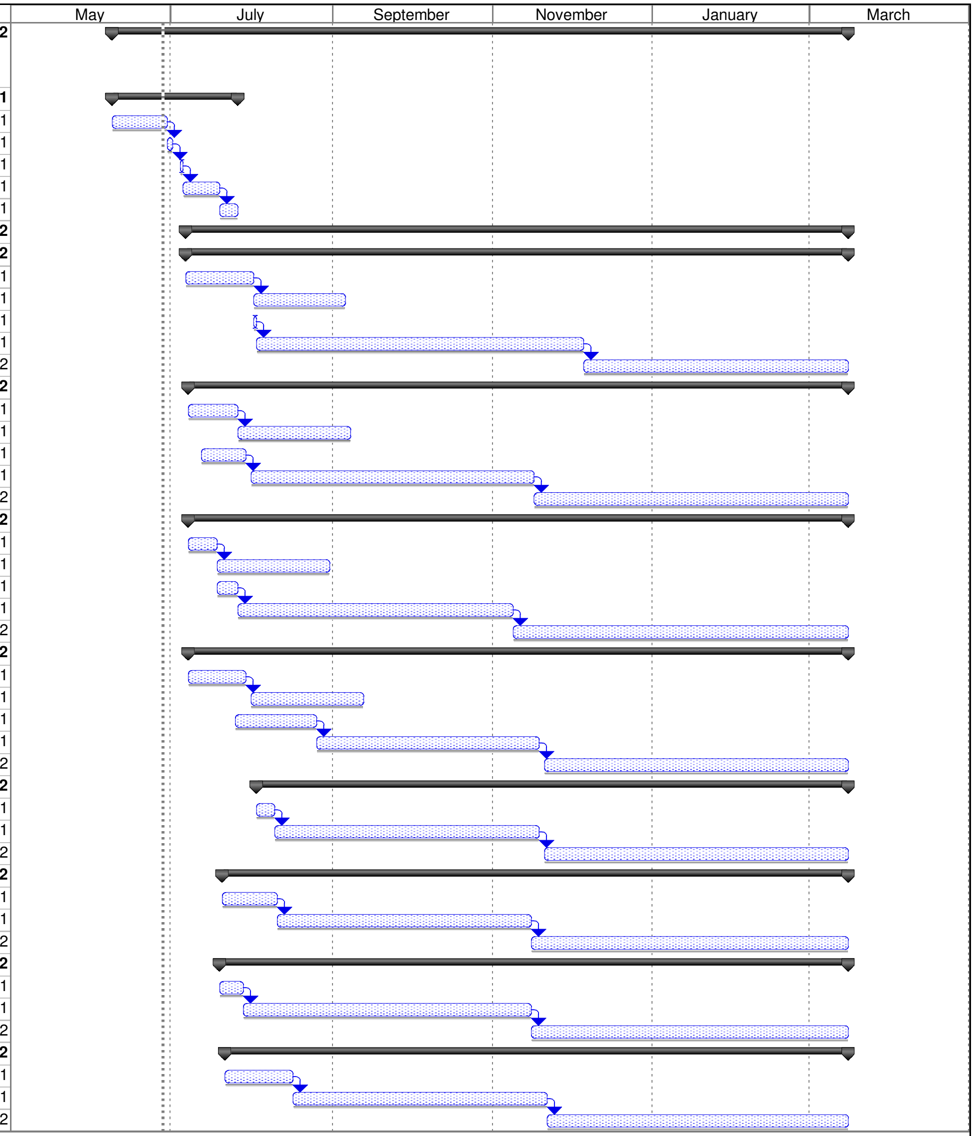

Figure 2-1
Project Schedule - Multiple MMRP Sites Intrusive Investigation

Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

SECTION 3

Field Investigation Plan

3.1 Overall Approach

A field investigation will be conducted to meet the objectives described in **Section 1.1**. All field activities will be conducted in accordance with the SOPs provided in the MRP MPP (CH2M HILL, 2008a). The field investigation will accomplish the project objectives through the following activities at each MRS:

- Site preparation (mobilization, buried utility location, site survey, and vegetation clearing)
- A MEC intrusive investigation of selected geophysical anomalies (**Section 4**)
- Pre-detonation sampling at locations with visible signs of MEC/MPPEH filler leakage into the adjacent soil (**Section 3.4.1**)
- Post-detonation sampling if a controlled detonation is necessary (**Section 3.4.2**)
- Environmental Sampling at select sites, as specified in **Sections 9** through **16**.
- Site restoration

Basic field investigation activities are defined below and referenced in the MRP MPP (CH2M HILL, 2008a). MEC intrusive investigation activities common to all sites are addressed in **Section 4** and site-specific field activities are presented in **Sections 9** through **16**.

3.2 Site Preparation and Restoration

The following subsections describe the procedures associated with site preparation, including mobilization of personnel and equipment and preparation for environmental investigation activities.

3.2.1 Mobilization

Mobilization will include identifying, briefing, and mobilizing staff, as well as securing and deploying equipment.

General Activities

- Identify/procure, package, ship, and inventory project equipment, including geophysical instrumentation, hand tools, and supplies
- Coordinate with local agencies, including MCB CamLej, Base Range Control, police, hospital, and fire department, as appropriate
- Test and inspect equipment

- Conduct site-specific training on the Work Plan Addendum and MEC procedures and hazards
- Review subcontractor Activity Hazard Analysis (AHA) forms
- Verify that all forms and project documentation are in order and project team members understand their responsibilities regarding completing 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 Work Plan Addendum and a review and acknowledgment of the SSHSP by all site personnel. Additional meetings will occur as needed, as new personnel, visitors, and/or subcontractors arrive at the sites.

3.2.2 Anomaly Avoidance

Anomaly avoidance will be practiced during buried utility location, site survey, vegetation clearance, well installation, and sampling, as described in **Section 2.3** of the SSHSP (**Appendix A**). These activities will require a UXO escort.

3.2.3 Buried Utility Location

The North Carolina One-Call Center will be contacted regarding the proposed subsurface sampling activities. A licensed and insured subsurface utility locator will be subcontracted by CH2M HILL to locate and mark underground utilities at sites UXO-02, UXO-11, and UXO-14. Utility locating will be performed within the entire pre-established areas at UXO-11 and UXO-14 and at up to 5 individual drilling locations at UXO-02.

3.2.4 Site Survey

Land surveying activities will be conducted in accordance with Section 7.4 of the MRP MPP (CH2M HILL, 2008). The surveying consists of two phases:

- **Phase 1**, the intrusive investigation subcontractor will ensure all surveying required for reacquisition of the anomalies selected for intrusive investigation is performed.
- **Phase 2** will be a survey, as appropriate, of the horizontal coordinates, top of casing elevation, and ground surface elevation of the new permanent monitoring wells and environmental characterization sampling locations in areas where the global positioning system (GPS) unit cannot get a clear signal, such as in densely vegetated areas.

MEC avoidance will be performed during all phases of surveying activities. Unexploded Ordnance (UXO) Technicians will escort surveying personnel while onsite, and will practice anomaly avoidance at all locations where stakes are driven.

3.2.5 Vegetation Clearing

If necessary and not damaging to the environment (Section 8), vegetation less than 3 inches in diameter will be removed to within approximately 6 inches of the ground surface to aid the intrusive investigations and access for environmental characterization sampling. Vegetation clearing will be accomplished using a combination of mechanical and manual methods, depending on site conditions. Mechanical removal would use chain saws while manual removal would use loppers, hand saws, or similar tools. Felled brush and trees would be left on the site. Trees, if any, greater than 3 inches in diameter will not be removed unless necessary. Overhanging vines and protruding branches that could interfere with the safe and effective performance of investigation activities will also be removed.

During the vegetation removal process, UXO technicians will conduct MEC avoidance activities in accordance with the SSHSP (**Appendix A**).

3.2.6 Site Restoration and Demobilization

Site Restoration

Damage caused by equipment or other site activities (such as deep ruts, intrusive investigation, or sampling holes) will be repaired and each site will be re-vegetated as necessary to prevent erosion.

Demobilization

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

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

3.3 Geospatial Information and Electronic Submittals

Methods, equipment, accuracy, and submittal requirements for location surveys and mapping are described in Section 7.4 of the MRP MPP (CH2M HILL, 2008a).

3.4 Field Sampling Plan

3.4.1 Pre-Detonation Soil Sampling and Analysis

Soil samples will be collected at locations with visible signs of MEC/MPPEH filler leakage into the adjacent soil. Upon consultation with the CH2M HILL project manager, grab samples, TR02-1, or incremental soils samples may be collected and analyzed for parameters as listed for post-detonation soil samples.

3.4.2 Post-Detonation Soil Sampling and Analysis

The use of explosives during controlled detonation/ blow-in-place (BIP) operations could potentially impact the surrounding soils. Soil samples will be collected at locations where controlled detonations/ BIP operations are conducted. Composite surface soil samples will be collected using the TR-02-1 sampling approach in the resulting crater, and the incremental sampling method will be utilized to collect a sample from outside of the crater. QA/QC samples will be collected in accordance with **Section 3.4.3** and are described in the UFP-SAP for Sites UXO-02 and UXO-14 and the UFP-SAP for UXO-11 and UXO-17 (**Appendix B**), or QAPP for the remaining sites (**Appendix C**).

Surface Soil TR-02-1 Sampling

Surface soil samples from the crater will be collected using the TR-02-1 approach described in the USACE Technical Report ERDC/CRREL TR-02-1, *Guide for Characterization of Sites Contaminated with Energetic Materials* (Thiboutot, et al., 2002). Each sampling location will be defined as an area measuring 1 meter (m) × 1 m. Coordinates of the sampling locations will be based on the center of the sampling area. Soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each 1 m × 1 m sampling location. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0 to 2 inches bgs. The sample increments at each location will be composited into a single sample following the *Homogenization of Soil and Sediment Samples* SOP in Appendix C of the MRP MPP (CH2M HILL, 2008a) prior to being transferred to the appropriate sample containers.

Incremental Soil Sampling

Additionally, the use of explosives during the MEC intrusive investigation could also impact the soils ejected from the crater. Surface soil samples will be collected outside the crater utilizing the incremental sampling method. The decision unit for the post-BIP sample collected outside the crater (outside the 1 m × 1 m TR-02-01 sampling area) will be roughly circular and centered upon the crater, with a radius of up to 15 m to encompass the visible ejecta pattern. The maximum radius of 15 m is based on work conducted by the US Army Engineer Research and Development Center entitled "Explosive Residues from Blow-in-Place Detonations of Artillery Munitions"(Pennington, et al., 2008). This paper concluded that the majority of the explosives residue mass falls within 15 m of the detonation center. The soil samples will be collected in accordance with the incremental sampling SOP in Appendix C MRP MPP (CH2M HILL, 2008a). At least 30 aliquots of soil will be collected from 0 to 2 inches bgs and homogenized in accordance with the SOP in Appendix C of the MRP MPP.

Samples from both inside and outside the detonation crater will be analyzed by a fixed base laboratory for the following parameters (**Table 3-1**):

- Explosives residues including PETN and nitroglycerin (SW-846 USEPA Method 8330)
- Perchlorate (SW-846 USEPA Method 6850)
- Target Analyte List (TAL) metals including mercury (SW-846 USEPA Methods 6010C and 7471B)

3.4.3 Environmental Characterization Sampling

Environmental characterization field sampling activities and laboratory analyses for Site UXO-02, UXO-11, UXO-14, and UXO-17 are presented in **Sections 11.4, 13.4, 14.4**, and **15.4** respectively.

TABLE 3-1
Summary of Post Detonation Sampling and Analysis Program

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis			
			TAL Metals	PETN and Nitroglycerin	Nitroaromatics and Nitromines	Perchlorate
Surface Soil Inside Crater	MRXX-SSYY-IC-11B	TR-02-01 methodology will be used to collect soil inside the crater from 0 – 2 inches bgs. Will allow for characterization of surface soil after BIP	X	X	X	X
Surface Soil Outside Crater	MRXX-SSYY-OC-11B	Incremental sampling methodology will be used to collect soil outside of the crater from 0 – 2 inches bgs. Will allow for characterization of surface soil after BIP	X	X	X	X

Notes and Abbreviations:

XX = MRP Site number: MR01 (for UXO-01[ASR#2.23]), MR02, MR05(for UXO-01[ASR#2.79 a, b, and c]), MR07, MR11, MR14, MR17, MR21

YY = Next consecutive soil sampling location number for each MRP Site: MR01 = 16, MR02=190, MR05 = 36, MR07 = 43, MR11 = 21, MR14 =35, MR17=20, MR21 = 41

3.4.4 Analytical Requirements and Sample Handling

Sample Preservation and Handling

Sample preservation must occur in the field immediately after collection. The containers supplied by the laboratory will contain the applicable preservative. This will protect field personnel from transporting, handling, and measuring concentrated acids and bases. QA/QC samples will be collected in the same types of preserved containers as the field samples. The preservative and holding-time requirements for analysis are detailed in Worksheet 19 of the UFP-SAP for UXO-02 and UXO-14 and the UFP-SAP for UXO-11 and UXO-17 (**Appendix B**), or in the QAPP for the remaining Sites (Attachment 1 of **Appendix C**).

Quality Assurance and Quality Control

QA/QC requirements for environmental characterization sampling, handling, and management are detailed in Section 4 of the MRP MPP (CH2M HILL, 2008a). Field QC samples (including field blanks, equipment blanks, duplicate samples, and matrix spike/matrix spike duplicate [MS/MSD] samples) will be collected during the investigation and submitted for laboratory analysis. Required QA/QC samples and the required frequency of collection are detailed in Worksheet 12 of the UFP-SAP for UXO-02 and UXO-14 and the UFP-SAP for UXO-11 and UXO-17 (**Appendix B**), or the QAPP for the remaining sites (Attachment 1 of **Appendix C**).

Sample Collection Frequencies

Table 3-2 presents the number of post-detonation field samples and their associated QA/QC samples.

TABLE 3-2
Post-Detonation Field and Quality Control Sample Summary

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equip. Blanks	Total No. of Samples to Lab
Post Detonation Samples							
Surface Soil	Explosives Residues including PETN and Nitroglycerin	24	8	1/1	1	8	43
	Perchlorate	24	8	1/1	1	8	43
	TAL Metals including mercury	24	8	1/1	1	8	43

Sample Identification System

The following is a general guide for sample identification; an electronic sample–tracking program will be used to manage the flow of information from the field sampling team to the laboratory and to internal and external data users. The tracking program is used to manage the entry of sampling-related data, such as station locations and field measurements.

While in the custody of the sampling team, the sample analysis data will be recorded in field logbooks, along with sample identity information.

Labels for samples to be shipped to a fixed-base laboratory will be produced electronically. If they cannot be produced electronically, they must be written legibly in indelible ink.

The following information typically is included on the sample label:

- Site name or identifier
- Unique sample identification number
- Date and time of sample collection
- Sampler's initials
- Sample matrix or matrix identifier
- Type of analyses to be conducted

Each analytical sample for soil will be assigned a unique number using the following format:

Site#-Media/Station# or *QA/QC-Year/Quarter* or *Depth Interval*

An explanation of each of these identifiers is given below.

Site#: This investigation includes MRP Sites under the MRP. Therefore, the prefixes "MR01 (for UXO-01[ASR#2.23]), MR02, MR05 (for UXO-01[ASR#2.79 a, b, and c]), MR07, MR11, MR14, MR17, MR21" may be used.

Media: GW = Groundwater from monitoring wells
SS = Surface soil
SB = Subsurface soil
SD = Sediment

Station#: Soil sampling locations will be numbered consecutively.

QA/QC: D = Duplicate sample (following sample type/number)
FB = Field blank
EB = Equipment rinseate blank
MS= Matrix Spike
SD = Matrix Spike Duplicate

Year/Quarter#: Year/Quarter indicators will be used for all samples. Each round of sampling will have a distinct identification number:

"11" = Year 2010
"B" = Sampling during the second quarter

Under this sample designation format, "MR08-SS01-11B" would mean the following:

<u>MR08-</u>SS01-11B	MMRP Site UXO-01
MR08-<u>SS01</u>-11B	surface soil sample from MEC/MPPEH location #1
MR08-SS01-<u>11B</u>	sampling in the second quarter of year 2011

Each analytical sample for groundwater will be assigned a unique number using the following format:

Well Name with GW or QA/QC replacing MW/-Year/Quarter or *Depth Interval*

Under this sample designation format, "MR02-IR69-GW11-11B" would mean the following:

MR02-IR69-GW12-11B	Groundwater sample from MR02-IR69-MW12
MR02-IR69-GW12-11B	sampling in the second quarter of year 2011
MR02-IR69-FD12-11B	Field duplicate groundwater sample from MR02-IR69-MW12

This sample designation format will be followed throughout the project. Required deviations to this format in response to field conditions will be documented in the field log book.

Sample Location

Actual soil, sediment, and surface water sample locations will be determined in the field and coordinates will be determined using a handheld GPS unit in the field. All coordinates will be recorded in the field logbook. Groundwater well locations will be surveyed and certified by a licensed NC surveyor.

Sample Packaging and Shipping

Samples will be packed in a cooler with bubble wrap packaging material and double-bagged ice. The samples will be either picked up at the site by the analytical laboratory or shipped to the laboratory via overnight courier. The Field Team Leader (FTL) is responsible for the following activities related to shipment of the samples:

- Verifying that all sample bottles are correctly labeled, sealed, and packaged
- Checking to ensure that sample bottles in each cooler correspond to the accompanying chain-of-custody form
- Affixing a custody seal to each cooler
- Using the appropriate labels and forms required for shipment

Custody of the samples will be maintained and documented at all times. Chain-of-custody will begin with the collection of the samples in the field and will continue through the analysis of the sample at the analytical laboratory (samplers must transfer custody to the person responsible for shipping the samples).

3.4.5 Investigation-derived Waste Management

All IDW generated during the investigation will be managed in accordance with the Waste Management Plan (WMP) in the MCB CamLej MPP (CH2M HILL, 2008c).

Anticipated IDW includes decontamination fluids and soil. Decontamination fluids generated during the field activities will be properly containerized in labeled 55-gallon drums and disposed of at a properly permitted offsite disposal facility. Soil IDW will be spread on the ground, around the sampling location.

3.5 Accident Prevention Plan

The APP is provided in the MRP MPP (CH2M HILL, 2008a). Because of the potential presence of MEC at this site, MEC avoidance techniques will be employed during the field investigation to reduce potential contact with MEC items. Procedures for conducting MEC avoidance are provided in the APP. Project-specific H&S is covered in the SSHSP (**Appendix A**).

3.6 Data Documentation and Processing Procedures

Documentation and processing of field data, laboratory data, and investigation results will be completed in accordance with Section 7.2 of the MRP MPP (CH2M HILL, 2008a).

3.7 Project File Requirements

This project will require the administration of a central project file. Project data and records will be managed in accordance with Section 7.3 of the MRP MPP (CH2M HILL, 2008a).

SECTION 4

MEC Intrusive Investigation Plan

Based on the results of the DGM surveys performed at the subject MRSs, MEC intrusive investigations of selected geophysical anomalies will be conducted to evaluate the nature and density of MEC that may be present at each site. The equipment, approach, methods, operation procedures, and QC to be used during the MEC intrusive investigation at each site are detailed below.

4.1 Planning

The following actions require advanced planning and will be conducted prior to mobilization:

- Finalize procurement actions for items and services needed during the mobilization
- Hold a pre-mobilization meeting and Operations Readiness Review (ORR) with the project team
- Coordinate with NAVFAC Project Manager (PM) and Base Point of Contact (POC) on notification to local stakeholders of upcoming project activities
- Reconfirm site personnel documentation of proper training, certifications, and medical monitoring

4.2 Site Preparation

The following subsections describe the procedures associated with site preparation, including mobilization of personnel and equipment and the activities required to prepare the sites for intrusive activities.

4.2.1 Mobilization

A mobilization period will include identifying, briefing, and mobilizing staff and securing and deploying equipment. Mobilization activities include general activities, establishing a command post, and a kickoff and safety meeting.

General Activities

- Identify/procure, package, ship, and inventory project equipment, including geophysical detection equipment, hand tools and supplies, and any other miscellaneous supplies
- Coordinate with local agencies, including police, hospital, and fire department, as appropriate
- Finalize operating schedules
- Establish MPPEH/MDAS collection areas

- Organize support facilities and test communication equipment
- Test and inspect equipment
- Assemble and transport the work force
- Conduct site-specific training on the Work Plan, SSHSP, and MEC procedures and hazards
- Verify that all forms and project documentation are in order and project team members understand their responsibilities with regard to completion of project reporting requirements

Command Post

- A project command post will be established in an area that is convenient to intrusive activities, but outside the exclusion zones (EZs) that will be established for intrusive activities.
- A field office will be established at the command post. The field office will be the central point of communications for the project and the command location for direction and coordination of intrusive activities at each site. Personnel will report to this location at the beginning of each workday for the daily H&S briefing. Site documents, including H&S records, will also be maintained in the field office.
- Lockable storage will be provided, either in the field office or in storage trailers, for portable field equipment.

Kickoff/Safety Meeting

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

4.3 MEC Removal Operations

MEC removal operations will be performed using hand excavation procedures to identify the source of individual anomalies following reacquisition of each anomaly. During environmental characterization sampling operations, MEC avoidance techniques will be used.

Previous DGM investigations at each site identified anomalies as representing potential subsurface MEC. One hundred percent of the selected anomalies identified during the DGM investigations will be intrusively investigated during MEC removal operations. Included in the anomalies for excavation are the QC seeds placed in these investigation areas prior to the DGM investigation.

4.3.1 Anomaly Reacquisition/Intrusive Investigation

All geophysical anomalies identified for excavation will be reacquired by an intrusive investigation team, composed of UXO technicians, to an exact location using real-time kinematics (RTKs) GPS and handheld magnetometer. After locating the approximate anomaly position with the GPS, the magnetometer will be used to confirm the exact position of the anomaly. If the anomaly is not immediately intrusively investigated, the location will be flagged using a PVC flag with the unique identifier number recorded in indelible ink. The location will be flagged 1 foot north of the actual field location of each reacquired anomaly shown on the tracking sheet.

Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches. The UXO teams performing this work will be composed of at least one UXO Technician II and up to four UXO Technicians II or I supervised by a Technician III. Details associated with this operation are included in **Appendix D**, MEC Removal SOPs, of this Work Plan. The SOPs will be provided by the subcontractor once procured. The following basic technique will be used for anomaly excavation:

- The UXO technician will investigate 1 foot south of the emplaced flag with the assistance of a Schonstedt GA-52Cx or equivalent to pinpoint the anomaly source.
- Until identified otherwise, the anomaly is assumed to be MEC. Excavation will be initiated adjacent to the subsurface anomaly. The excavation will continue until the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with an appropriate geophysical instrument.
- Using progressively smaller and more delicate tools to remove the soil carefully, the excavation team will expand the sidewall to expose the metallic item for inspection and identification without moving or disturbing the item.
- Once the item is exposed for inspection, the excavation team will determine whether the item is MEC, MPPEH, or other debris.
  - If the item is MEC, a positive identification will be documented and confirmed by another UXO Technician. If confirmed, the MEC item will be disposed of by BIP methods, or, if the item is safe to move (as confirmed by the Senior UXO Supervisor [SUXOS] and UXO Safety Officer [UXOSO]), the item may be moved for controlled detonation and/or consolidation. For MEC, including suspect munitions items, the SUXOS and UXOSO must determine that the risk associated with movement is acceptable and that the movement is necessary for the efficiency of the activities being conducted or the protection of people, property or critical assets. In such cases, the responsible SUXOS and UXOSO must agree with the risk determination and document this decision in writing prior to movement of the MEC or suspect munitions item. UXO qualified personnel may determine that MPPEH is safe for on-site movement. Written documentation and concurrence of the UXOSO is not required.
  - Following demolition/removal of the MEC item, MPPEH, or other debris, the area will be rechecked with an EM61-MK2 to ensure that another item was not hidden beneath the removed item or otherwise remaining within the two-foot excavation depth. The excavation team will then record the results of the excavation, backfill the hole, and move on to the next marked subsurface anomaly location.
  - If the item is other debris, it will be collected and segregated away from MPPEH.

– If the item is MPPEH, the procedures presented in **Section 4.6** will be followed.

4.4 Removal Verification

The following is the procedure to be followed for QC inspections of the intrusive investigation:

- After the dig team intrusively investigates an anomaly location, the hole is to be left open to the depth investigated and the PVC flag placed in the hole or bent after the investigation is completed.
- The UXO QC Specialist (UXOQCS) will inspect at least 10 percent of the intrusively investigated anomaly locations using an EM61-MK2 geophysical instrument to determine whether all detectable metallic items within a 3-foot radius of the hole to a depth of 2 feet have been removed. The locations checked will be distributed in a spatially representative sample across each grid.
- All holes related to intrusive investigations will be filled back to original grade or covered before departing the project site each day.
- Anomaly locations inspected, along with results of the inspection and corrective actions planned in the event that the UXOQCS determines that inspection results require a change in intrusive team procedures or a re-performance of any work, will be documented and provided to the CH2M HILL Project Geophysicist.
- Additional QC analysis of intrusive results versus original amplitude of geophysical anomalies will be performed by the CH2M HILL Project Geophysicist. Anomaly locations that are determined to need re-investigation through this process will be re-inspected.

4.5 Demobilization

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

- All areas to be investigated will be verified as completed.
- Restoration of the site to an appropriate level will be verified.
- All equipment will be inspected, packaged, and shipped to the appropriate location.
- All facilities-support infrastructures will be dismantled and shipped to the appropriate location, and the field site will be returned to the original condition prior to mobilization.

4.6 Procedures for Reporting and Disposition of MEC and MPPEH Items

This section discusses the procedures for reporting and disposing of MEC and MPPEH items encountered during the project, including the responsibilities of personnel, overall safety precautions, data reporting, transportation, safe holding areas, operations in populated/sensitive areas, demolition operations, and required engineering controls and EZs for intrusive operations and intentional detonations. The general responsibilities of project personnel are described in Section 2.5 of the MRP MPP (CH2M HILL, 2008a).

4.6.1 Overall Safety Precautions

The overall safety precautions described in Section 2.5.1 of the MRP MPP (CH2M HILL, 2008a) will be adhered to during the intrusive investigation.

Qualified UXO personnel will dispose of all MEC items (including MPPEH and MDEH items) using explosive demolition procedures by countercharging these items with an explosive donor charge and detonating the donor charge. This will be performed by a demolition team consisting of one UXO Technician III as the Demolition Supervisor and two UXO Technician II personnel, with the SUXOS responsible for the operation.

4.6.2 Data Reporting

Data reporting for each metallic anomaly will be done in accordance with Section 2.5.2 of the MRP MPP (CH2M HILL, 2008a).

4.6.3 Operations in Populated and Sensitive Areas

Operations in populated areas will require an EZ Enforcement Plan. An EZ Enforcement Plan will be developed in coordination with Base facility personnel to guide enforcement of the EZ during intrusive and controlled detonation activities in these populated areas.

Sensitive habitats include jurisdictional wetlands and habitat for threatened and endangered species. MEC operations in these areas will be conducted in accordance with the EPP (**Section 8**) to be protective of these sensitive areas and all threatened and endangered species.

4.6.4 Exclusion Zones and Separation Distances

The primary munition with the greatest fragmentation distance (MGFD) was used to calculate the explosives safety-quantity distance (ESQD) arcs for each site. On sites with non-fragmenting munitions, the maximum credible event (MCE) will be used instead of the MGFD. Primary MGFDs or MCE by site are provided in the Base-wide or site-specific ESS.

EZs, which include the team separation distance (TSD) for personnel conducting intrusive operations within each MRS, the minimum separation distance (MSD) for non-essential personnel, the public transportation route (PTR) distance, and the inhabited building distance (IBD) for bare explosives and MPPEH under specified scenarios, are provided in the ESSs for the sites, where applicable.

If fragmenting MEC is found with a larger MGFD, or if non-fragmenting MEC with a larger MCE than the primary MCE is found, usage of the primary MGFD or MCE will be discontinued and the ESQD arcs for the contingency MGFD will be used. If the contingency MGFD ESQD arcs are implemented, MARCORSYSCOM will be notified using the *MRS Identification and Notification Report* in NOSSA Instruction 8020.15C (NOSSA, 2011).

If the new item's MGFD or MCE is larger than the contingency MGFD, work at the site will stop and an ESS amendment will be submitted for that site.

4.6.5 MEC and MPPEH Hazards Classification, Storage, and Transportation

MEC and MPPEH will be classified and transported as discussed in Section 2.6 of the MRP MPP (CH2M HILL, 2008a). MEC will not be stored. MPPEH will be stored at the MPPEH Collection Point specified in the ESS for each site and stored as discussed in Section 2.6 of the MRP MPP (CH2M HILL, 2008a). All MEC/MPPEH will be classified as class/division (C/D) 1.1. MEC and MPPEH will not be transported offsite.

A systematic approach will be used for collecting, inspecting, and segregating site debris. The approach is designed so that materials undergo a continual evaluation/inspection process from the time they are acquired until the time they are removed from the site. Segregation procedures begin at the time the item is discovered by the UXO Technician. At this point, the UXO Technician makes a preliminary determination as to the classification of the item into one of three categories and the UXO Technician III confirms the item to be MEC, MPPEH, or other debris.

MPPEH that has undergone two 100 percent visual inspections by two UXO Technician IIIs who are independent of each other in the reporting chain and are authorized to sign the Requisition System Document (DD) Form 1348-1 as not presenting an explosive hazard is considered to be MDAS. MDAS will be stored in a locked container at least 50 feet from the MPPEH collection point. MDAS and other debris may be transported offsite via a DD Form 1348-1.

4.6.6 MEC Disposition

At sites with approved ESSs, MEC and MPPEH will be demilitarized by BIP methods or will be relocated for demolition if determined safe to do so by the SUXOS and UXOSO. If MEC is discovered at sites without approved ESSs (Site UXO-01[ASR#2.79 a, b, and c] and UXO-14), Base EOD will be contacted for disposal.

4.6.7 MPPEH Disposition

MPPEH will be visually inspected and independently re-inspected for explosive hazards as discussed in Section 2.7.2 of the MRP MPP (CH2M HILL, 2008a). MPPEH that cannot be classified as MDAS will be disposed of in the same manner as MEC.

4.6.8 Recording, Reporting, and Implementation of Lessons Learned during the Project

Lessons learned will be performed in accordance with Section 2.8 of the MRP MPP (CH2M HILL, 2008a).

SECTION 5

Explosives Management Plan

The management of explosives to support the removal and disposal of MEC and MPPEH items that may be discovered during the intrusive investigation at the subject sites will be done in accordance with Section 3 of the MRP MPP (CH2M HILL, 2008a).

SECTION 6
Explosives Siting Plan

Explosives safety criteria for planning and siting explosives operations for the MEC removal action at the subject sites are provided in Section 4 of the MRP MPP (CH2M HILL, 2008a). There are no planned or established MEC detonation areas. In accordance with the approved ESSs for the sites, if applicable, MEC/MPPEH will be BIP where found, or MEC/MPPEH may be relocated for demolition if determined safe to do so by the SUXOS and UXOSO.

SECTION 7

Quality Control Plan

All applicable work conducted by CH2M HILL and its subcontractors at the subject sites will be performed in accordance with the QCP in Section 8 of the MRP MPP (CH2M HILL, 2008a). The QCP describes the QC approach and procedures to be employed during the intrusive investigation at the sites.

The specific QC audit procedures for the definable features of work (DFOWs) to be employed at the subject sites, including the phase during which it is performed, the frequency of performance, the pass/fail criteria, and actions to take if failure occurs, are presented in **Table 7-1**. QC forms and checklists are provided in **Appendix D.**

TABLE 7-1
Definable Features of Work Auditing Procedures
Intrusive Investigation Work Plan Addendum
Sites UXO-01 (ASR#2.23), UXO-01(ASR#2.79a,b,c), UXO-7, UXO-11, UXO-14, and UXO-21
MCB CamLej
Jacksonville, North Carolina

Definable Feature of Work with Auditable Function	Responsible Person(s)[1]	Audit Procedure	QC Phase[2]	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
Planning						
Geographical Information System (GIS) Setup (Pre-mobilization Activities)	Project GIS Manager	Verify GIS system has been set up and is ready for site data.	PP	O	GIS system has been set up and is ready for site data.	Do not proceed with field activities until criterion is passed.
Document management and control (Pre-mobilization Activities)	Project Manager	Verify appropriate measures are in place to manage and control project documents.	PP	O	Appropriate measures are in place to manage and control project documents.	Do not proceed with field activities until criterion is passed.
Data Management (Pre-mobilization Activities)	Project Manager, Project Geophysicist	Verify appropriate measures are in place to manage and control project data.	PP	O	Appropriate measures are in place to manage and control project data.	Do not proceed with field activities until criterion is passed.
Subcontracting (Pre-mobilization Activities)	Project Manager, Site Manager	Verify subcontractor qualifications, training, and licenses.	PP/IP	O	Subcontractors' qualifications, training, and licenses are up to date and acceptable.	Ensure subcontractor provides the qualifications, training, and licenses or change subcontractor.
Technical and Operational approach (Project Planning)	Project Manager/Site Manager	Verify technical and operational approaches have been agreed on by the project team.	PP/IP	O	Technical and operational approaches have been agreed on by project team and incorporated into the Work Plans.	Do not proceed with field activities until criterion is passed
Work Plan preparation and approval	Project Manager	Verify Work Plan prepared and approved.	PP/IP	O	Work Plan has been approved	Do not proceed with field activities (excluding site mobilization) until criterion is passed.
Field Operations						
Site preparation (Mobilization)	Project Manager, Site Manager	Verify local agencies are coordinated.	PP/IP	O	Local agencies are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	Project Manager, Site Manager	Verify equipment has been inspected and tested.	PP/IP	E	Equipment passes inspection and testing.	Proceed only with activities for which equipment has passed inspection and testing.
Site preparation (Mobilization)	Project Manager, Site Manager	Verify communications and other logistical support is coordinated.	PP/IP	O	Communications and other logistical support are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	Project Manager, Site Manager	Verify emergency services have been coordinated.	PP/IP	O	Emergency services are coordinated.	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	UXOQCS, Project Manager, Site Manager	Verify site-specific training is performed and acknowledged.	PP/IP	O	Site-specific training is performed and acknowledged	Do not proceed with field activities until criterion is passed.
Site preparation (Mobilization)	UXOQCS, Project Manager, Site Manager	Hold pre-mobilization meeting and ORR with the project team.	PP/IP	O	Project plans are reviewed and acknowledged by team members.	Do not proceed with field activities until criterion is passed.
Reacquisition Accuracy	Project Geophysicist	Confirm that anomalies are located within a 1-meter radius of flagged location as selected by DGM.	FP	E	Anomaly located within 1-meter radius of flag	If anomalies are being located beyond 1-meter radius of flag or are not being located within 1-meter radius of the flag, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Intrusive Investigation	UXOQCS	Verify equipment tested in accordance with (IAW) Section 6.0 of the Work Plan	IP/FP	D	Equipment testing performed and tests passed	Repair or replace instrument.
Intrusive Investigation	UXOQCS	Verify team separation distance is as established in Section 3.6.4 of the Work Plan	IP/FP	D	Team separation distance is appropriate for work being performed	Stop activities until appropriate separation distance is being followed
Intrusive Investigation	UXOQCS	Verify that the item recovered during intrusive excavations is appropriate to the amplitude of the initial anomaly detected during the DGM.	IP/FP	D	Recovered item is appropriate to the amplitude of the initial anomaly detected during the DGM.	Return to the location of the item excavation to determine if additional anomalies are present. If item being recovered continue to be inappropriate for the amplitude as detected during the DGM, a root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
Intrusive Investigation	QC Geophysicist	QC seed items recovered	IP/FP	E	All QC seed items in area of operation recovered.	A root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action

TABLE 7-1
Definable Features of Work Auditing Procedures
Intrusive Investigation Work Plan Addendum
Sites UXO-01 (ASR#2.23), UXO-01(ASR#2.79a,b,c), UXO-7, UXO-11, UXO-14, and UXO-21
MCB CamLej
Jacksonville, North Carolina

Definable Feature of Work with Auditable Function	Responsible Person(s)[1]	Audit Procedure	QC Phase[2]	Freq. of Audit	Pass/Fail Criteria	Action if Failure Occurs
Intrusive Investigation	UXOQCS	Verify operations are conducted IAW Work Plan, MEC Removal SOPs, and the HSP: - Survey/Sweeps - MEC Surface Sweeps - Analog Detection and Removal Actions - DGM Anomaly Investigation - Ammunition and Explosives Transportation - Explosives Storage and Accountability - Disposal/Demolition Operations - Scrap Inspection Operations	IP/FP	D	Work performed IAW Work Plan, referenced MEC SOPs, and the HSP.	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
MPPEH/MD Management	UXOQCS	Verify inspections conducted IAW Work Plan	IP/FP	D/E	Inspections being conducted IAW Work Plan	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
MPPEH/MD Management	UXOQCS	Verify certification conducted IAW Work Plan	IP/FP	D/E	Certification is conducted IAW Work Plan	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
MPPEH/MD Management	UXOQCS	Verify disposal is conducted IAW Work Plan	IP/FP	D/E	Disposal is conducted IAW Work Plan	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary
Site Restoration	Site Manager	Verify the damage caused by excavation and removal of anomalies is backfilled and laid to original grade and completed IAW Work Plan.	FP	O	Damage caused by excavation and removal of anomalies is backfilled and laid to original grade	Ensure that damage caused by excavation and removal of anomalies is backfilled and laid to original grade
Demobilization	Project Manager, Site Manager	Verify facilities-support infrastructures are dismantled and shipped to appropriate location and area is returned to original condition.	FP	O	Facilities-support infrastructures are dismantled and shipped to appropriate location and site is returned to original condition.	Ensure that all support facilities are removed and that the site is returned to original condition
Final Project Reports and Closeout						
Site Specific Final Report preparation and approval	Project Manager, Project Geophysicist	Verify tabulations of all material identified/recovered during the field actions are accurate and complete.	IP	O	Tabulations of all material identified/recovered during the field actions are accurate and complete.	Ensure tabulations of all material identified/recovered during the field actions are accurate and complete.
Site Specific Final Report preparation and approval	Project Manager, Project Geophysicist	Verify all dig sheets where geophysical mapping and investigation performed are accurate and complete.	FP	O	All dig sheets where geophysical mapping and investigation performed are accurate and complete.	Ensure all dig sheets where geophysical mapping and investigation performed are accurate and complete
Archiving	GIS Manager	Verify data back-up systems are in place.	IP	O	Data back-up systems are in place	Ensure data back-up systems are in place
Project Closeout	Project Manager	Verify purchase orders have been closed out.	IP	O	Purchase orders have been closed out	Ensure purchase orders are closed out
Project Closeout	Project Manager	Verify invoices completed and approved.	IP	O	Invoices completed and approved	Ensure invoices are completed and approved

Notes:
IAW = in accordance with

QC Phase	Frequency
PP = Preparatory Phase	O = Once
IP = Initial Phase	D = Daily
FP = Follow-up Phase	W = Weekly
	E = Each occurrence

[1] The responsible person (if other than the UXOQCS) is the individual with whom the UXOQCS will coordinate with to ensure compliance with requirements and to verify that any necessary follow-up actions are taken.
[2] Documentation to be in accordance with the three-phase control process as outlined in the Quality Control Plan.

SECTION 8

Environmental Protection Plan

8.1 Regional Ecological Summary

A summary of the regional ecology is provided in Section 9.1 of the MRP MPP (CH2M HILL, 2008a).

8.2 Endangered/Threatened Species within the Project Sites

Many protected species are known to occur on and adjacent to MCB CamLej, species such as the American alligator, the green sea turtle, the loggerhead sea turtle, the piping plover, the red-cockaded woodpecker, the bald eagle, the seabeach amaranth, and the rough-leaf loosestrife (USMC, 2006). **Table 8-1** 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 three federally-protected avian species (American bald eagle, piping plover, and red cockaded woodpecker) that are known to occur on the base. MCB Camp Lejeune worked with the USFWS to establish guidelines for military training in red-cockaded woodpecker cluster sites. Additionally, through Section 7 consultation, the Base implemented measures to properly manage the red-cockaded woodpecker habitats located on base (loblolly pine *[Pinus taeda]* and longleaf *[Pinus palustris]* and pond pine *[Pinus serotina]* areas). These guidelines and measures are presented in the 2007-2011 Integrated Natural Resources Management Plan (INRMP) (USMC, 2006). MCB CamLej's red-cockaded woodpecker population has been continually 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. Site UXO-02 is within the red-cockaded woodpecker management areas (**Figure 8-1**). The remaining sites are not near any of the known occurrences of these species.

A bald eagle nest is documented on MCB CamLej at the junction of Sneads Creek and the New River. At its closest point from the subject sites, it is approximately 2.5 miles from Site UXO-02. Three protective buffers that restrict ground and air-use activities have been established at approximately 750 feet, 1,000 feet, and 1,500 feet from the nest site. The subject sites are not within any of these buffer zones. Non-nesting eagles may use the sites for foraging habitat. However, the proposed work is not expected to impact any special habitat where eagles would concentrate.

The Atlantic Coast populations of piping plovers tend to prefer sandy beaches close to the primary dunes of barrier islands and coastlines. They prefer sparsely vegetated open sand, gravel, or cobble for nesting sites and forage along the rack line where the tide washes up onto the beach. Of the subject sites, Site UXO-02 is the only site that may contain suitable habitat for the piping plover. Site UXO-02 is located along the west bank of the New River and in close proximity to the Atlantic Ocean coastline. Piping plovers are not expected to be present (feeding, breeding, and nesting, for example) at Site UXO-02 however.

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.

Two of the four federally listed plant species known from the vicinity 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 red-cockaded woodpecker 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 feet from the outermost individuals. Red-cockaded woodpecker habitat is present at Site UXO-02 and rough-leaved loosestrife may be present also. None of the other MRSs are located within rough-leaved loosestrife sites.

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 and thus is not located on or adjacent to the subject sites.

Environmental reviews completed in preparation for the INRMP determined that the remaining species listed in **Table 8-2** are not expected to exist at any of the sites addressed by this Work Plan. No adverse effects to listed species are expected to result from the proposed work at the subject sites. Project design features have been developed to prevent effects on listed species.

A qualitative evaluation of why state listed threatened and endangered species potentially found in Onslow County for terrestrial and aquatic habitats are not expected at the subject sites is provided in **Table 8-2**. The evaluation is based on state-listed species that are not also federally listed species and described above. No state listed species are expected to be found in the area of investigation at the subject sites.

8.3 Wetlands within the Project Sites

Jurisdictional wetland areas are known to be located at Site UXO-01 (ASR#2.79 a, b, and c) (**Figure 8-2**), Site UXO-02 (**Figure 8-3**), and Site UXO-21 (**Figure 8-4**). Several jurisdictional wetland areas are located near the sites: 75 feet northwest of Site UXO-02, 375 feet south of Site UXO-11, and approximately 750 feet east of Site UXO-14. In order to access geophysical anomalies, install groundwater monitoring wells, and collect samples, vegetation removal may be necessary at the sites. Work in wetland areas will be avoided to the extent practical. No direct effects on wetlands are expected to result from the proposed project activities. No significant soil disturbance is anticipated from planned site work as described in this WP. No wetlands on or downstream of the subject sites are expected to be affected by the project.

Owing to the size of the areas of investigation, the sites are below the threshold for requiring storm water pollution prevention plans. In addition, minimal ground disturbance would result from anomaly investigation, groundwater well installation, and sampling.

8.4 Cultural and Archaeological Resources within the Project Sites

The investigation activities proposed to support this Work Plan involve intrusive activity. The probability that any significant cultural or archeological resources will be impacted by the field investigation is low. Consultation with the Base archaeologist confirms no cultural or archaeological resources are known to be within the project areas. If any unmapped cultural or archaeological materials or resources are discovered within the project areas, the Base archaeologist will be notified to provide guidance on performing further work in the area.

8.5 Water Resources within the Project Sites

No water resources are expected to be impacted by the project. Site UXO-01 (ASR#2.23) and UXO-14 do not encompass, nor are bounded or bordered by, surface water sources. Site UXO-01 (ASR#2.79 a, b, and c) contains and borders some small surface water drainage features. Site UXO-02 is bounded to the east by the New River and to the north by a tributary of the New River. A small surface water drainage ditch is located in the southeastern boundary of Site UXO-11. Site UXO-17 encompasses a small surface water drainage feature. Site UXO-21 encompasses one surface water source, a channel/stream occurring within the wetland area of the site.

There is adequate vegetative buffer surrounding the sites to protect surface water from additional runoff. Because minimal ground disturbance would result from anomaly investigation, groundwater well installation, and sampling, no storm water pollution prevention plan would be required.

8.6 Coastal Zones within the Project Sites

Onslow County is subject to the rules and policies of the North Carolina Coastal Resources Commission, which administers the Coastal Area Management Act (CAMA). The CAMA requires permits for development in Areas of Environmental Concern (AECs) if the area meets all of the following conditions:

- It is in one of the 20 counties covered by CAMA
- It is considered "development" under CAMA
- It is in, or it affects, an AEC established by the Coastal Resources Commission
- It doesn't qualify for an exemption

"Development" includes activities such as dredging or filling coastal wetlands or waters, and construction of marinas, piers, docks, bulkheads, oceanfront structures, and roads.

The intrusive investigation activities at the subject sites will include excavation of target anomalies, installation of groundwater wells, and sample collection. These activities do not fit the definition of "development" under CAMA; therefore, a CAMA permit is not necessary for this project.

8.7 Vegetation to be Removed within the Project Sites

Limited vegetation removal may be performed at the site to access geophysical anomalies, for installation of groundwater monitoring wells at Site UXO-02 and UXO-17, and for sampling activities. Only vegetation less than 6-inches in diameter will be cut to within approximately 6 inches of ground surface. Consultation with the Base wildlife biologist confirms no threatened or endangered species have been located within the project area at Sites UXO-01 (ASR#2.23), UXO-01 (ASR#2.79 a, b, and c), UXO-11, UXO-14, UXO-17, and UXO-21. At Site UXO-2, consultation with the Base wildlife biologist for the PA/SI confirmed vegetation clearance of small trees and understory brush will improve red-cockaded woodpecker habitat within UXO-02 (Haught, 2008, personal communication). Procedures in place will prevent excessive exposure of bare ground.

8.8 Existing Waste Disposal Sites within the Project Sites

Former chemical waste disposal sites are present at Site 69, located within Site UXO-02. Records indicate that the site was an active dump from the early 1950’s until 1976. From 1950 to 1976, Site 69 was used for the trench disposal of chemical wastes, including PCBs, solvents, and pesticides. Site 69 also has a suspected history of chemical agent (CA) disposal. Fifty to sixty 55-gallon drums of mustard or nerve agent were allegedly buried in two trenches at Site 69 (Water and Air Research, 1983). Chemical Agent Detector Kits, similar to the M18A2, have been observed at the site and this has led to speculation of the potential for the presence of CAIS (such as K941, K951). However, no physical evidence to support the presence of CAIS has been discovered (Baker, 2000).

No other waste disposal sites are present at the subject sites.

8.9 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 MPP (CH2M HILL, 2008a). No permits have been determined to be required for the proposed work.

8.10 Detailed Procedures and Methods to Protect and/or Mitigate the Resources/Sites Identified

During the proposed work, general surveys of the project areas 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 federally-protected plants be identified within the project area, the specimens will be flagged for easy relocation and verification

- Should cultural or archaeological materials or resources be discovered within a project area, a qualified archaeologist will be notified to provide guidance on performing further work in the area.
- Should the performed work activities impact an environmental resource, the PM will seek the guidance of the qualified ecologist to determine appropriate mitigation measures.

TABLE 8-1
Species Potentially Occurring on or Adjacent to CamLej, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Intrusive Investigation Work Plan Addendum
Sites UXO-01 (ASR#2.23), UXO-01(ASR#2.79a,b,c), UXO-7, UXO-11, UXO-14, and UXO-21
MCB CamLej, 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.

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MCB CamLej, 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 8-1
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MCB CamLej, 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 five 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.

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MCB CamLej, 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*)

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MCB CamLej, 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 8-2
Species Potentially Occurring on or Adjacent to CamLej, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the State of North Carolina
Intrusive Investigation Work Plan Addendum
Sites UXO-01 (ASR#2.23), UXO-01(ASR#2.79a,b,c), UXO-7, UXO-11, UXO-14, and UXO-21
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	State Status	Habitat
Cystopteris tennesseensis	Tennessee Bladder-fern	E-SC	calcareous rock outcrops
Lophiola aurea	Golden-crest	E	very wet, mucky habitats in pine savannas
Muhlenbergia torreyana	Pinebarren Smokegrass	E	cypress savannas
Platanthera integra	Yellow Fringeless Orchid	T	savannas
Spiranthes longilabris	Giant Spiral Orchid	T	savannas
Utricularia olivacea	Dwarf Bladderwort	T	limesink ponds, beaver ponds
Crotalus adamanteus	Eastern Diamondback Rattlesnake	E	Inhabits upland dry pine forest, pine and palmetto flatwoods, sandhills and coastal maritime hammocks, long-leaf pine/turkey-oak habitats, grass-sedge marshes and swamp forest, mesic hammocks, sandy mixed woodlands, xeric hammocks, salt marshes, as well as wet prairies during dry periods. In many areas it seems to use burrows made by gophers and gopher tortoises during the summer and winter (1).
Crotalus horridus	Timber Rattlesnake	SC	Generally, this species is found in deciduous forests in rugged terrain. During the summer, gravid females seem to prefer open, rocky ledges where the temperatures are higher, while males and non-gravid females tend to spend more time in cooler, denser woodland with a more closed forest canopy (2).
Gelochelidon nilotica	Gull-billed Tern	T	sand flats on maritime islands [breeding sites only]
Haliaeetus leucocephalus	Bald Eagle	T	mature forests near large bodies of water (for nesting); lakes and sounds [nesting sites; regular non-breeding sites]
Malaclemys terrapin centrata	Carolina Diamondback Terrapin	SC	salt or brackish marshes, estuaries; southern half of the coast
Micrurus fulvius	Eastern Coral Snake	E	pine-oak sandhills, sandy flatwoods, maritime forests
Neotoma floridana floridana	Eastern Woodrat - Coastal Plain Population	T	forests, mainly in moist areas
Rynchops niger	Black Skimmer	SC	sand flats on maritime islands [breeding sites only]
Sistrurus miliarius	Pigmy Rattlesnake	SC	This species reportedly inhabits flatwoods, sandhills, mixed forests, flood plains, and is also found near lakes and marshes (3).

TABLE 8-2
Species Potentially Occurring on or Adjacent to CamLej, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the State of North Carolina
Intrusive Investigation Work Plan Addendum
Sites UXO-01 (ASR#2.23), UXO-01(ASR#2.79a,b,c), UXO-7, UXO-11, UXO-14, and UXO-21
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	State Status	Habitat
Sterna hirundo	Common Tern	SC	sand flats on maritime islands [breeding sites only]
Sternula antillarum	Least Tern	SC	beaches, sand flats, open dunes

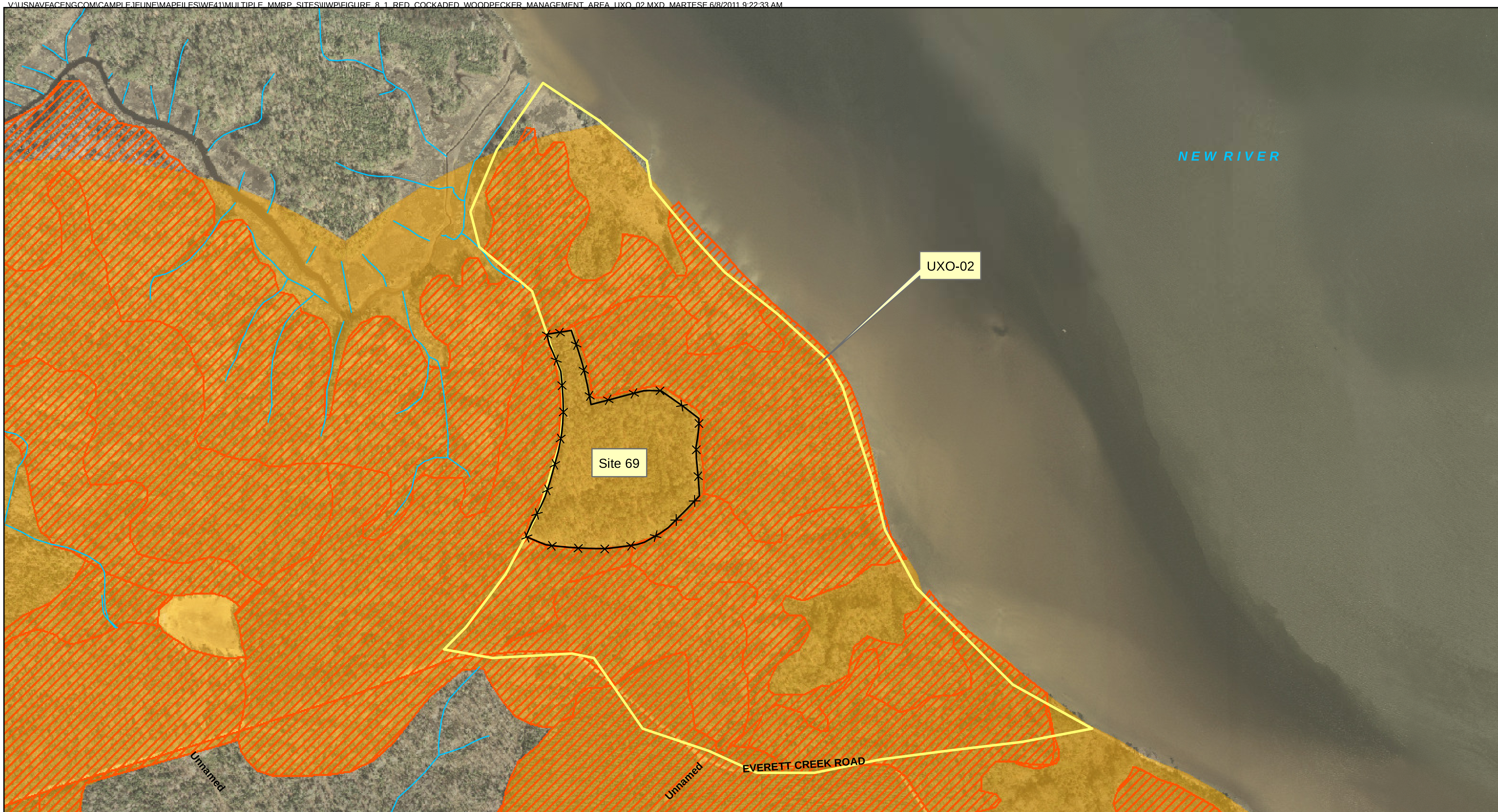
Code	Status	Code	Status
E	Endangered	SR	Significantly Rare
T	Threatened	EX	Extirpated
SC	Special Concern	P_	Proposed (used only as a qualifier of the ranks above)
C	Candidate		

(1) Campbell JA, Lamar WW. 2004. The Venomous Reptiles of the Western Hemisphere. Comstock Publishing Associates, Ithaca and London. 870 pp. 1500 plates.

(2) Norris R. 2004. Venom Poisoning in North American Reptiles. *In* Campbell JA, Lamar WW. 2004. The Venomous Reptiles of the Western Hemisphere. Comstock Publishing Associates, Ithaca and London. 870 pp. 1500 plates.

(3) McDiarmid RW, Campbell JA, Touré T. 1999. Snake Species of the World: A Taxonomic and Geographic Reference, vol. 1. Herpetologists' League.

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_8_1_RED_COCKADED_WOODPECKER_MANAGEMENT_AREA_UXO_02.MXD MARTESE 6/8/2011 9:22:33 AM



Legend

- Site 69 Fenceline
- Surface Water
- Site UXO-02 Boundary
- Red-cockaded Woodpecker Habitat Management Areas
- Red-cockaded Woodpecker Partition Area

N

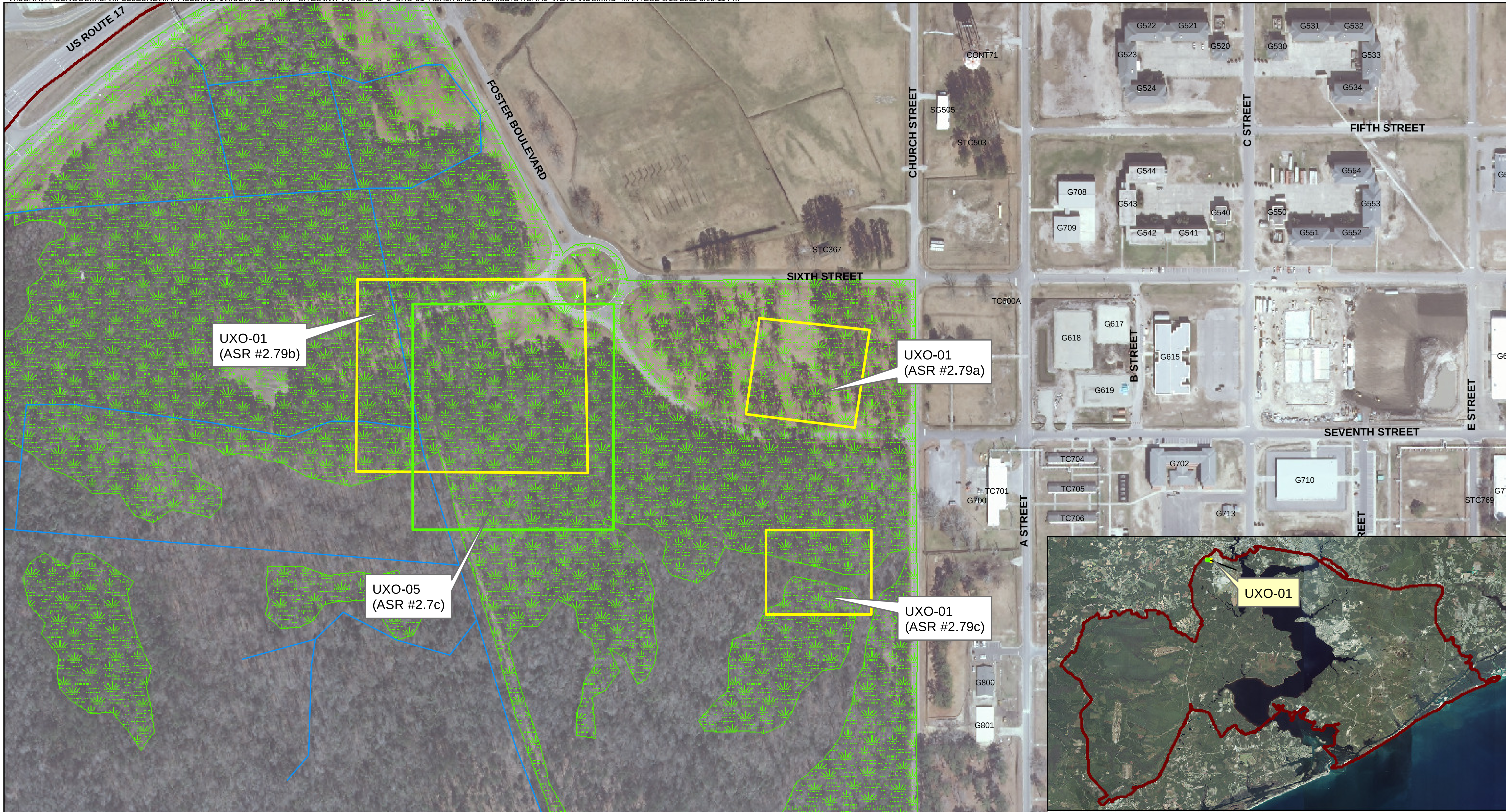
0 250 500 1,000 Feet

1 inch = 500 feet

Figure 8-1
Site UXO-02 Red-cockaded Woodpecker Habitat Management Areas
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_8_2_UXO-01_ASR2.79ABC_JURISDICTIONAL_WETLANDS.MXD MARTESE 6/15/2011 3:08:11 PM



Legend

- Surface Water
- Site UXO-05- Former Miniature Anti-Tank Range (ASR #2.7c) boundary
- Site UXO-01- Former Gas Chamber (ASR #2.79a, b, and c) boundary
- Jurisdictional Wetland Area
- Installation Boundary

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 8-2
Site UXO-01 (ASR #2.79a, b, and c) Jurisdictional Wetlands
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IWP\FIGURE_8_3_SITE_UXO-02_JURISDICTIONAL_WETLANDS.MXD MARTESE 6/15/2011 3:12:30 PM

Legend

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

N

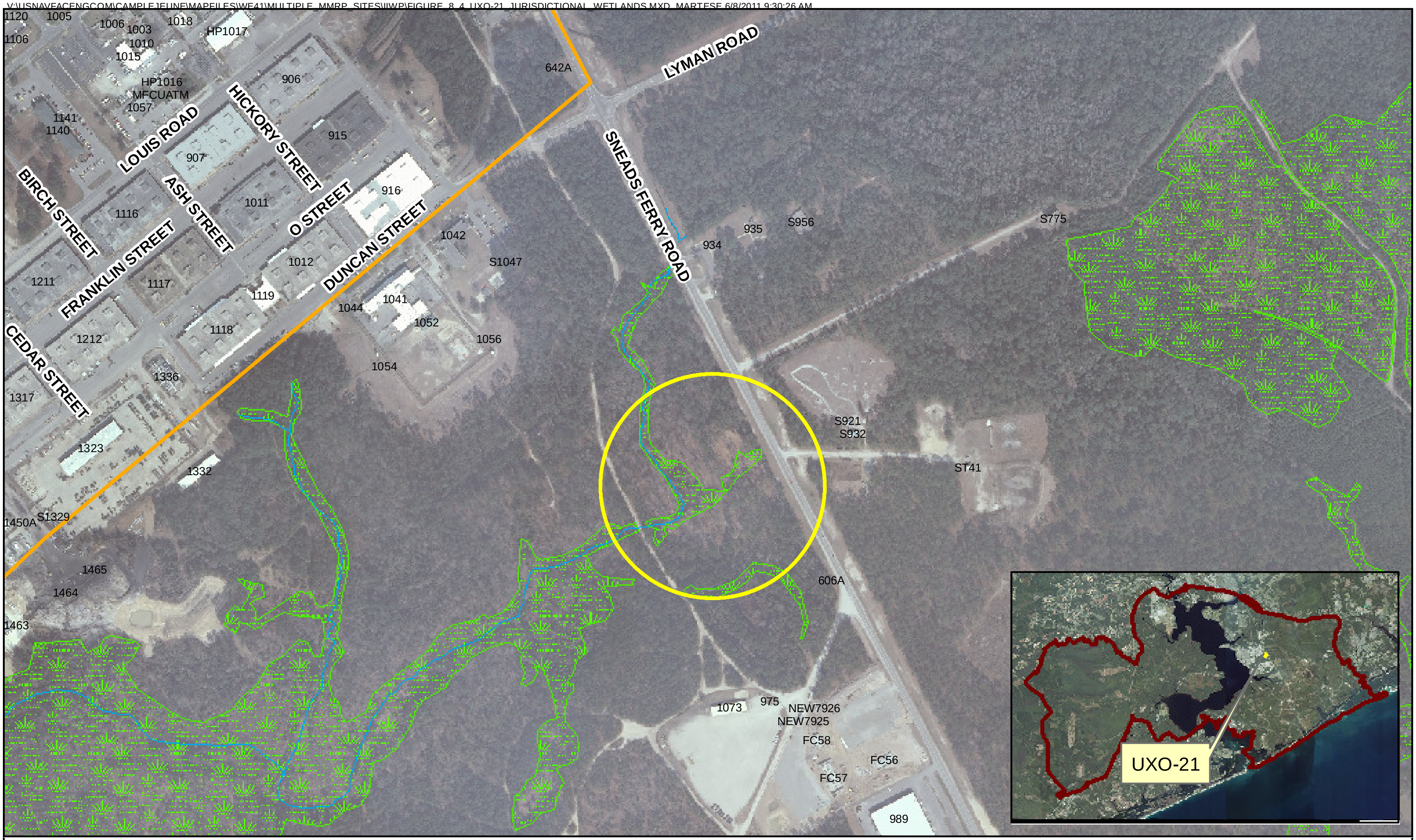
0 800 1,600 Feet

1 inch = 800 feet

Figure 8-3
Site UXO-02 Jurisdictional Wetlands
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IWP\FIGURE_8_4_UXO-21_JURISDICTIONAL_WETLANDS.MXD MARTESE 6/8/2011 9:30:26 AM



Legend

- Surface Water
- Jurisdictional Wetlands
- Site UXO-21- Former D Area Gas Chamber (2D MAR DIV) (ASR #2.204)
- Hadnot Point Boundary
- Installation Boundary

N

0 300 600 1,200 Feet

1 inch = 600 feet

Figure 8-4
Site UXO-21 Jurisdictional Wetlands
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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SECTION 9

UXO-01—Former Live Hand Grenade Course (ASR #2.23)

9.1 Site Location and Description

Site UXO-01 – Former Live Hand Grenade Course, covers approximately 10 acres of gently sloping terrain, approximately 80 percent of which is heavily vegetated with trees and thick undergrowth. A portion of the investigation area is mowed regularly for an unnamed gravel access road as well as gas and power line easements. Overhead electrical and underground communications utilities traverse the western edge of Site UXO-01. A sanitary sewer force main runs southwest to northeast through Site UXO-01 and a high pressure natural gas pipe line crosses the site from southeast to northwest. No historical structures or remnants of a former hand grenade course were observed. The site is located west of Holcomb Boulevard near the intersection with NC Route 24 (**Figure 9-1**).

9.2 Site Geology and Hydrogeology

Soil cores were collected between ground surface and depths up to 24 ft bgs as part of the PA/SI for Site UXO-01 (ASR#2.23). Boring logs of the sediments indicated that the soils range from clay and silt to very fine-to fine grained sand in laterally-discontinuous layers (CH2M HILL, 2008b). These shallow soils are consistent with those described as the undifferentiated formation (Cardinell, et al., 1993).

The water table of the surficial aquifer occurs in the undifferentiated formation at this site. Site-specific hydrogeologic information was derived from the installation of three shallow temporary monitoring wells in the surficial aquifer during the PA/SI. In July 2008, shallow groundwater flow was northwest towards Northeast Creek, a tributary of the New River. The horizontal hydraulic gradient was 0.0006 ft/ft, based upon the July 30, 2008 potentiometric surface map of the water table (CH2M HILL, 2008b).

9.3 Site History and Previous Investigations

9.3.1 History

Site UXO-01 (ASR#2.23) is identified as an MMRP site based on historical information contained in the *Final Range Identification and Preliminary Range Assessment (*USACE, 2001). The Range Identification and Preliminary Range Assessment states that the only reference found on this range was in Camp Training Order 5-1946, dated March 19, 1946, which states that the range was established under Camp Training Order Number 7-1945, dated March 19, 1945. The range was disestablished in March 1946 and is no longer used for the firing of live ammunition (USACE, 2001). According to the Range Identification and Preliminary Range Assessment (USACE, 2001), munitions used during active use of the range included fragmentation, offensive, and practice grenades. The Site boundary was provided by MCB CamLej; the site boundary supplied by the base is consistent with the site boundary shown in the 1946 Range Overlay Map (Plate 4, USACE, 2001).

Archival review indicates that the area comprising Site UXO-01 (ASR#2.23) was a former live hand grenade course used for troop training; the area is not associated with an active impact area, range, range fan, safety danger zone (SDZ), or with the disposal of military munitions (CH2M HILL, 2009a). The site was used during World War II (WWII) for troop maneuvers that included the use of fragmentation, offensive, and practice grenades. Disposal of munitions and or burial of munitions is not reported or suspected at the site. The use of CWM is unlikely based on the archival review.

The area is currently used extensively for hunting, with the most common forms being black powder hunting or bow hunting. Hunting is regulated by the Base Game Warden. Spent small arms ammunition (such as shotgun shells and small-caliber rifle bullets) may be present as a result of hunting on the site (Richardson, 2007, personal communication). The area is undeveloped with access restricted to military personnel and individuals with proper access permits. The general public is precluded from entry to the area.

9.3.2 Visual Site Inspection

In July 2007, CH2M HILL conducted a visual site inspection of Site UXO-01 (ASR#2.23). The purpose of the inspection was to note distinguishing features associated with the site. Site UXO-01 (ASR #2.23) was confirmed to be heavily vegetated with some open area consisting of a gravel road and utility easements. No historical structures or remnants of a former hand grenade course were observed.

9.3.3 Preliminary Assessment/Site Inspection

As part of the 2008 PA/SI, a DGM survey was conducted over approximately 10 percent (approximately 1 acre) of Site UXO-01 (ASR #2.23) using a single-coil EM61-MK2 system. The DGM survey yielded a total of 249 geophysical anomalies representing potential subsurface MEC, as shown on **Figure 9-2**. Intrusive investigation of the anomalies was not conducted during this phase of investigation.

Sampling of environmental media consisted of:

- Nine surface soil samples (0-2 inches below ground surface [bgs]) collected from three decision units (DUs) using the incremental sampling procedure described in Appendix C of the MRP MPPs (CH2M HILL, 2008a).
- Fifteen surface soil samples collected using the TR-02-1 approach, as described in the PA/SI Work Plan (CH2M HILL, 2008b).
- One unsaturated subsurface soil sample was collected at each of eight soil boring locations at a depth immediately above the estimated water table.
- Three groundwater samples collected from temporary groundwater monitoring wells.

Samples were submitted to an analytical laboratory and analyzed for explosives residues (by SW-846 United States Environmental Protection Agency [USEPA] Method 8330), perchlorate (by USEPA Method 6850), and total metals (by ILM05). Groundwater samples were additionally analyzed for dissolved metals (by ILM05).

The preliminary human health risk-based screening indicated that exposure to MC in soil and groundwater from Site UXO-01 would not result in any unacceptable human health risks (CH2M HILL, 2009a). Therefore, no further assessment of soil or groundwater based on human health risks was recommended. Based on the analytical results and risk assessment, no risks to populations of ecological receptors were expected from MC at the site. Because no unacceptable human health or ecological risks were identified from exposure to site media, no further environmental characterization sampling was recommended. However, the PA/SI recommended further investigation to assess the nature of the geophysical anomalies detected during the DGM survey.

9.4 Field Activities

9.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

9.4.2 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the QAPP (**Appendix C**).

9.4.3 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-01 (ASR #2.23) will include reacquisition and investigation of the 249 anomalies that were identified during the PA/SI as representing potential subsurface MEC (**Figure 9-2**). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission

Intrusive operations at Site UXO-01 (ASR #2.23) will be conducted in accordance with the Base-wide ESS (CH2M HILL, 2011d). Intrusive investigation activities will not be conducted until approval of the ESS is received from MARCORSYSCOM.

Operations in Populated and Sensitive Areas

Site UXO-01 (ASR#2.23) is not located in a populated area. No jurisdictional wetlands or habitat for threatened or endangered species are located within the site.

Exclusion Zones and Separation Distances

The primary MGFD for the site is the MKII hand grenade. Exclusion zone parameters are provided in **Table 9-1** and are shown on **Figure 9-3.**

TABLE 9-1
Exclusion Zone Parameters for Site UXO-01 (ASR #2.23)

Operation	Sited as	Exposed Site (ES)	Basis	ESQD[1] (feet)
Primary MGFD (Mk II Grenade)				
Manual operations[2]	Unintentional detonation	UXO teams	K40 of the MGFD	20
Manual operations[2]	Unintentional detonation	Public and non-essential personnel	HFD of the MGFD	62
MEC treatment up to 3.0 lb NEW[3]	Intentional detonation	Public and all personnel	MFD-H of the MGFD	521[4]
MPPEH Collection				
MPPEH collection area for onsite consolidation, storage, and re-inspection (up to 1 lb NEW)[5]	Metal Storage Container (e.g., 55-gallon drum or CONEX box)	Non-essential personnel in structures	Inhabited Building Distance (IBD)[6]	291
		Non-essential personnel in the open	Public Transportation Route (PTR)[6]	175

Table notes:

1. From Fragmentation Data Review Form, Updated 15 April 2011.
2. Manual operations involve excavating anomalies with hand tools.
3. The K328 of the MEC treatment may not exceed the MFD-H of the MGFD. Operations will be limited to 3 lb MEC treatment for consolidated shots. For 3 lb, the K328 distance equals 473 feet which is less than the MFD-H of 521 feet. The K328 distance is calculated using the formula $D=328*W^{(1/3)}$.
4. This distance can be reduced by employing engineering controls authorized by DDESB TP-16.
5. MPPEH storage allows storage of up to 1 pound (lb) NEW.
6. Based on Table 7-9, Ordnance Publication (OP)-5, Volume 1, 7th Revision (NAVSEA, 2010). PTR is 60 percent of IBD.

Legend

Site UXO-01- Former Live Hand Grenade Course (ASR #2.23) Boundary

Installation Boundary

N

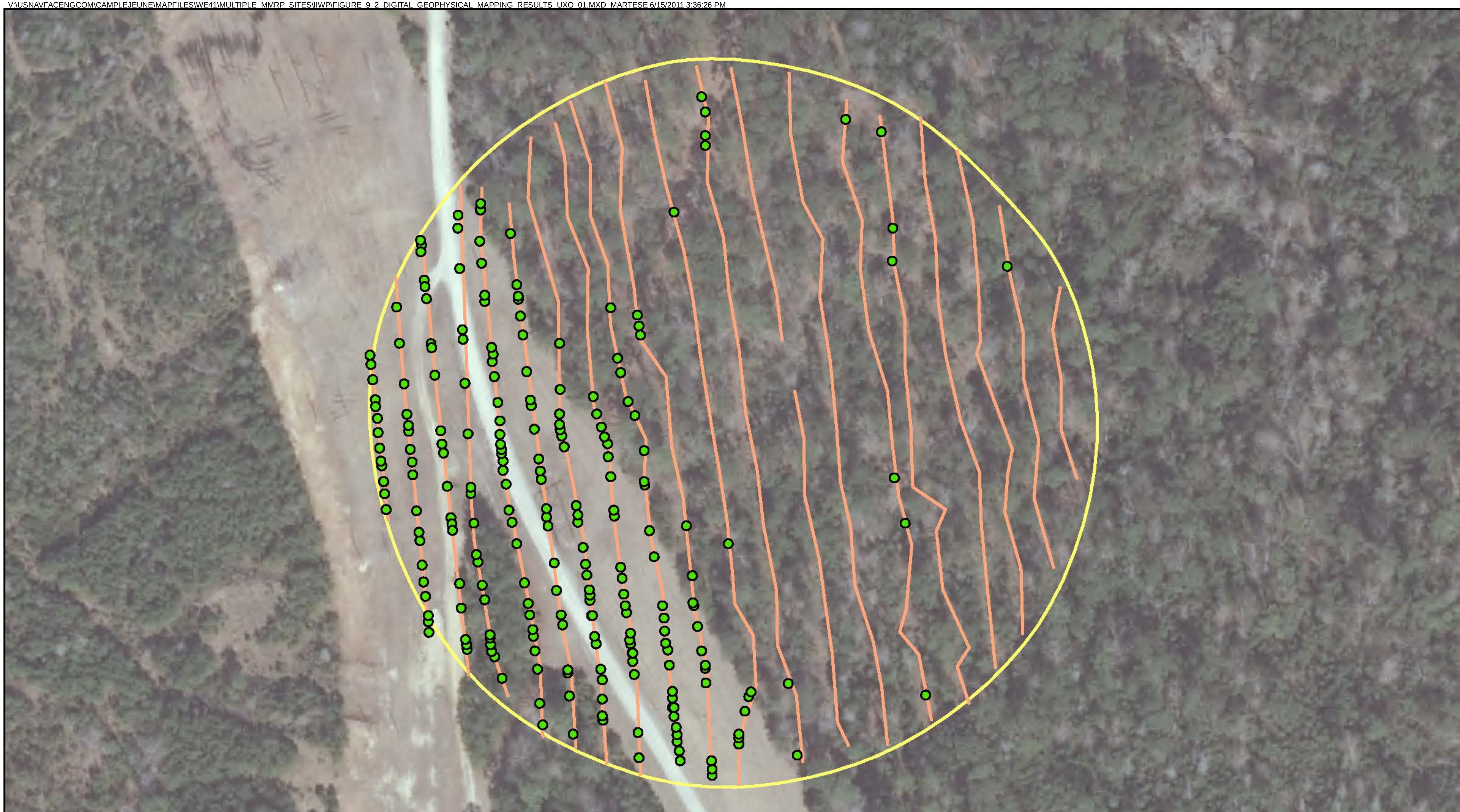
0 100 200 400 Feet

1 inch = 200 feet

Figure 9-1
UXO-01 (ASR #2.23) Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_9_2_DIGITAL_GEOPHYSICAL_MAPPING_RESULTS_UXO_01.MXD MARTESE 6/15/2011 3:36:26 PM



Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transect
- Site UXO-01 (ASR #2.23) Boundary

N

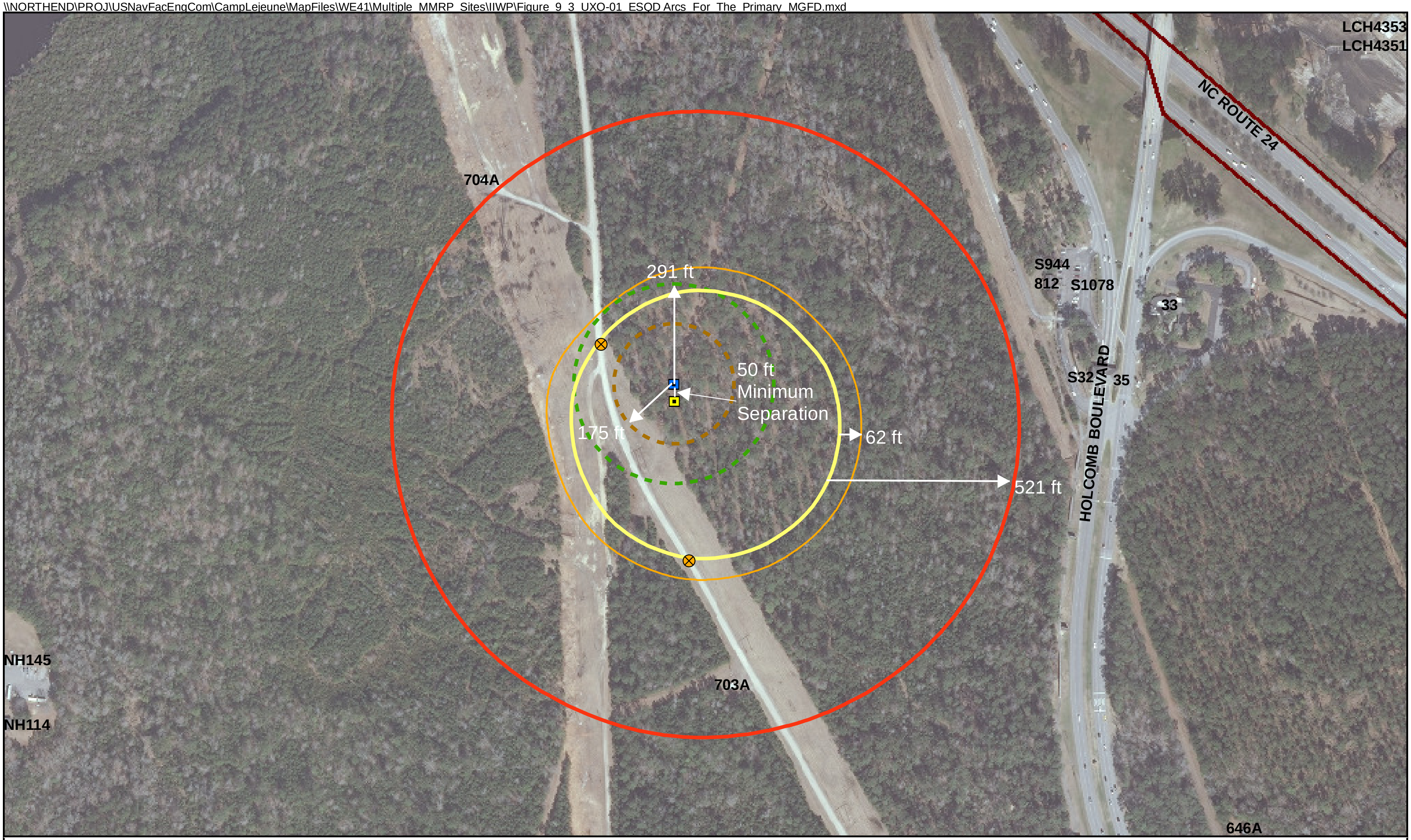
0 50 100 200 Feet

1 inch = 100 feet

Figure 9-2
UXO-01 (ASR#2.23) Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\Figure_9_3_UXO-01_ESQD Arcs_For_The_Primary_MGFD.mxd



Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point PTR (175 ft)
- MPPEH Collection Point IBD (291 ft)
- Intentional Detonation EZ, All Personnel (521 ft)
- Unintentional Detonation EZ, Public and Non-Essential Personnel (62 ft)
- Installation Boundary
- Site UXO-01 (ASR #2.23) Boundary

N

0 200 400 800 Feet

1 inch = 400 feet (1:4,800)

Figure 9-3
Site UXO-01 (ASR #2.23)
ESQD Arcs for the Primary MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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SECTION 10

UXO-01—Former Gas Chamber (ASR #2.79a, b, and c)

10.1 Site Location and Description

Site UXO-01, the former B-3 Gas Chamber, consists of three areas defined by ASR#2.79a, ASR#2.79b, and ASR#2.79c (**Figure 10-1**). ASR #2.79a is located west of Church Street, between Sixth Street and Seventh Streets, and covers an area of approximately 2.5 acres. This area is undeveloped and sparsely to heavily wooded (ASR #2.79b) and is located to the west of Church Street and south of Sixth Street, and covers an area of approximately 9.88 acres. Approximately 6.55 acres of ASR #2.79b overlap with Site UXO-05, Former Miniature Anti-Tank Range (ASR #2.7c). Picnic areas are currently located within the bounds of ASR #2.7c and ASR #2.79b. Area 2.79c is located south of 7th Street, west of Church Street, and covers an area of approximately 2 acres. This area is undeveloped and consists primarily of jurisdictional wetlands.

10.2 Site Geology and Hydrogeology

Soil cores recovered between ground surface and depths up to 12 feet bgs during the PA/SI at UXO-01 (ASR#2.79 a, b, and c) indicate that the site soils consist of clay and silt to medium-coarse sand in laterally-discontinuous layers (CH2M HILL, 2009b). These descriptions are consistent with those of the undifferentiated formation (Cardinell, et al., 1993).

The water table of the surficial aquifer occurs in the undifferentiated formation at this site. Site-specific hydrogeologic information was derived from the installation of ten temporary surficial aquifer monitoring wells. **S**hallow groundwater within the northern portion of the site flows south, south-east towards Brinson Creek and the New River. The maximum horizontal hydraulic gradient in August 2008 was 0.008 ft/ft (CH2M HILL, 2009b).

10.3 Site History and Previous Investigations

10.3.1 History

Three portions of UXO-01 are located in close proximity, but not contiguous to one another, and designated as Area 2.79a, 2.79b, and 2.79c. The Former B-3 Gas Chamber (UXO-01, ASR#2.79a, b, and c), was operated between 1953 and 1958 (USACE, 2001), and involved the use of chemical warfare training agents, such as tear gas. There is no evidence that CWM would have been used during training activities, however, the area surrounding gas chambers was often used for other chemical training. Therefore, it has been suggested that CA identification sets and riot control hand grenades may have been used at the Former B-3 Gas Chamber (UXO-01, ASR#2.79 a, b, and c) (USACE, 2001). Materials potentially present in the surface soils at the Former B-3 Gas Chamber (UXO-01, ASR#2.79 a, b, and c) may include tear gas canisters and degradation byproducts of chloroacetophenone (CN) and o-chlorobenzylidenemalonitrile (CS).

Because approximately 6.55 acres of Area 2.79b overlap with Site UXO-05, Former Miniature Anti-Tank Range (ASR#2.7c), the site history of UXO-05 is also pertinent to Area 2.79b.

The overlapping portion of Site UXO-05, Former Miniature Anti-Tank Range (ASR#2.7c) and the Former B-3 Gas Chamber (UXO-01) were identified as MMRP sites based on historical information contained in the *Final Range Identification and Preliminary Range Assessment* (USACE, 2001). This information was used as a basis for determining the locations and boundaries of Sites UXO-05 (ASR#2.7) and UXO-01 (ASR#2.79a, b, and c).

The Former Miniature Anti-tank Range (UXO-05) was used between 1942 and 1944. According to the *Final Range Identification and Preliminary Range Assessment* (USACE, 2001), .22 caliber small arms ammunition was fired at a moving target car located on a transverse track. Possible evidence (or remnants) of past munitions use that may reasonably be anticipated to be found at this site consists of spent .22 caliber munitions casings and unspent .22 caliber cartridges at or near the firing line and lead projectiles within the impact area. Munitions cartridges and/or casings would initially be located at the surface, construction and other disturbances may have caused the items to become buried over time. The area was also used extensively during WWII for blank-fire and non-firing events (Lowder, 2005). The range layout and extent were determined based on a standard range fan configuration.

Site UXO-05 and the Former B-3 Gas Chamber (UXO-01, ASR#2.79a, b, and c), were both used for military troop training. The areas are not associated with an active impact area, range, range fan, safety danger zone (SDZ), or the disposal of military munitions. Site UXO-05 does have a WW II history of military troop maneuvering and reports of small arms ammunition use in the area. Disposal and or burial of munitions is not reported or suspected. The area is undeveloped with access restricted to military personnel. The general public is precluded from entry to the area.

10.3.2 PA/SI

A PA/SI was conducted in 2008 for Site UXO-05 (ASR#2.7) and Site UXO-01 (ASR#2.79a, b, and c) to evaluate the potential presence and nature of effects on environmental media resulting from historical munitions use at the subject sites and to determine whether additional investigation and/or remediation activities were necessary. DGM was performed using a single-coil EM61-MK2 system over a portion of Site UXO-01 (ASR#2.79a, b, and c). A total of 3,872 linear meters of DGM transect data was collected covering approximately 12 percent of Site UXO-01 (ASR#2.79a, b, and c). A total of 353 anomalies were identified as representing potential subsurface MEC(CH2M HILL, 2009b). There was no apparent pattern to the geographical distribution of anomalies. The areas of the site covered by the DGM and the anomalies representing potential subsurface MEC are shown on **Figure 10-2.**

Environmental sampling for MC analysis within Site UXO-01 (ASR#2.79a, b, and c) consisted of:

- Nine surface soil samples collected from three DUs using the incremental sampling procedure

- Seven discrete surface soil samples collected from 0-2 inches bgs
- Five subsurface soil samples collected from unsaturated soil core collected immediately above the estimated water table using DPT.
- Four groundwater samples collected from temporary and permanent groundwater wells

Samples were submitted to an analytical laboratory and analyzed for explosives residues (by SW-846 USEPA Method 8330), perchlorate (by USEPA Method 6850), total metals (by ILM05). Discrete surface soil samples were additionally analyzed for semivolatile organic compounds (SVOCs) including tear gas constituents (CN, CS, and degradation products) (SW-846 USEPA Method 8270C).

The human health risk evaluation for Site UXO-05 and Site UXO-01 (ASR#2.79 a, b, and c) was performed in two phases. No constituents of potential concerns (COPCs) for soil or sediment were identified from the Phase I evaluation; therefore, exposure to soil or sediment would not be expected to result in any unacceptable human health and no further evaluation of soil or sediment for human health risk is necessary. The Phase I screening evaluation indicated the potential for risks associated with exposure to surface water and groundwater; therefore, these media were evaluated in Phase II.

The Phase II evaluation demonstrated that exposure to surface water by recreationalists and groundwater by construction workers would not result in any risks greater than USEPA target levels; therefore, no further evaluation of surface water and groundwater for human health risk is necessary. Since it is not likely that the surficial aquifer will ever be used as a potable water supply, it is unlikely that the detected concentrations of iron or arsenic in the temporary monitoring wells pose a risk to potential residents or industrial workers. Based on the sampling results, no further evaluation of groundwater for human health risks is necessary. The ecological risk screening concluded that no risks to populations of ecological receptors are expected at Site UXO-01 (ASR#2.79a, b, and c). Because no unacceptable human health or ecological risks were identified from exposure to site media, no further environmental characterization sampling was recommended.

The report recommended that the nature of the 353 geophysical anomalies detected during the DGM at Site UXO-01 (ASR#2.79a, b, and c) be evaluated by conducting an intrusive investigation. Since only small caliber munitions are associated with Site UXO-05 (ASR #2.7c), the geophysical anomalies identified in this overlap area are attributed to Site UXO-01 historical uses (CH2M HILL, 2009b).

10.4 Field Activities

10.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

10.4.2 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the QAPP (**Appendix C**).

10.4.3 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-01 (ASR #2.79a, b, and c) will include reacquisition and investigation of the 353 anomalies that were identified during the PA/SI as representing potential subsurface MEC (**Figure 10-2**). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission

The intrusive investigation at Site UXO-01(ASR#2.79 a, b, and c) will be conducted in accordance with the Base-wide ESS (CH2M HILL, 2011d). Intrusive investigation activities will not be conducted until approval of the ESS is received from MARCORSYSCOM.

Operations in Populated and Sensitive Areas

Site UXO-01 (ASR#2.79a, b, and c) includes a portion of a traffic circle. An EZ Enforcement Plan will be developed in coordination with Base facility personnel to guide enforcement of the EZ during intrusive and controlled detonation activities in these populated areas.

Sensitive habitats include jurisdictional wetlands in portions of Site UXO-01 (ASR#2.79b and c). MEC operations in these areas will be conducted in accordance with the EPP (**Section 8**) to be protective of these sensitive areas and all threatened and endangered species.

Exclusion Zones and Separation Distances

The primary MCE for the site is the grenade, hand, riot, CN, M7A1. Exclusion zone parameters are provided on **Table 10-1** and are shown on **Figure 10-3.**

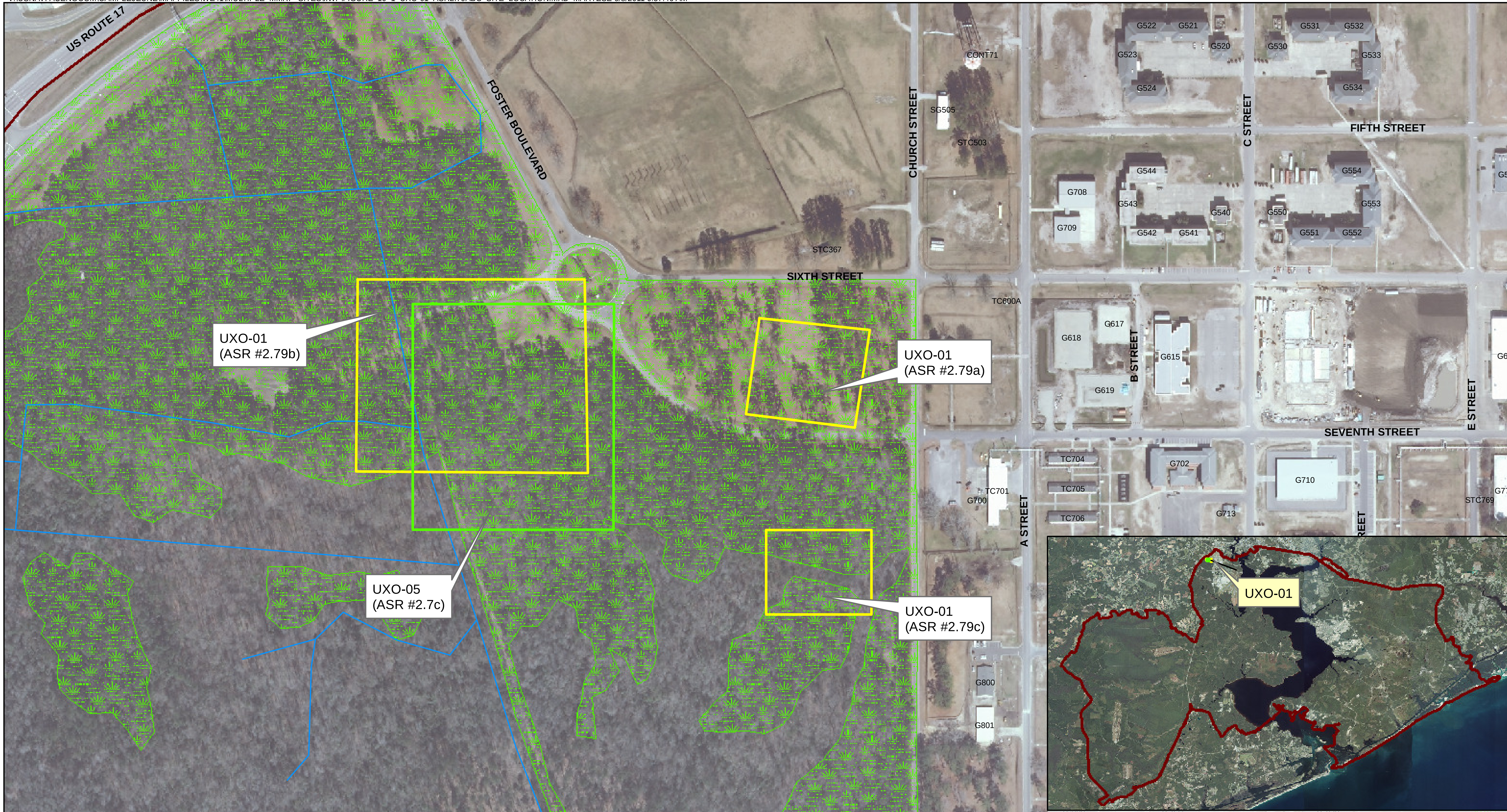
TABLE 10-1
Exclusion Zone Parameters for Site UXO-01 (ASR #2.79a, b, and c)

Operation	Sited as	ES	Basis	ESQD (feet)
Primary MCE (Grenade, Hand: Riot, CN, M7A1)				
Manual operations[1]	Unintentional detonation	UXO teams	K40 of the MCE	37
Manual operations[1]	Unintentional detonation	Public and non-essential personnel	K40 of the MCE	37
MEC treatment up to 1 lb NEW	Intentional detonation	Public and all personnel	K328 of 1 lb NEW[2]	328[3]
MPPEH Collection				
MPPEH collection area for onsite consolidation, storage, and re-inspection (up to 0.5 lb NEW)[4]	Metal Storage Container (e.g., 55-gallon drum or CONEX box)	Non-essential personnel in structures	Inhabited Building Distance (IBD)[5]	236
		Non-essential personnel in the open	Public Transportation Route (PTR)[5]	142

Table notes:

1. Manual operations involve excavating anomalies with hand tools.
2. The K328 for the primary MCE is 302 feet. Instead of this distance, the K328 value for 1 lb NEW will be utilized. K328 distance is calculated using the formula $D=328*W^{(1/3)}$.
3. This distance can be reduced by employing engineering controls authorized by DDESB TP-16.
4. MPPEH storage allows storage of up to 0.5 lb NEW.
5. Based on Table 7-9, Ordnance Publication (OP)-5, Volume 1, 7th Revision (NAVSEA, 2010). PTR is 60 percent of IBD.

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_10_1_UXO-01_ASR2.79ABC_SITE_LOCATION.MXD MARTESE 6/8/2011 9:57:46 AM



Legend
- Surface Water
- Site UXO-05- Former Miniature Anti-Tank Range (ASR #2.7c) boundary
- Site UXO-01- Former Gas Chamber (ASR #2.79a, b, and c) boundary
- Jurisdictional Wetland Area
- Installation Boundary

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 10-1
UXO-01 (ASR #2.79a, b, and c) Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_10_2_DIGITAL_GEOPHYSICAL_MAPPING_RESULTS_UXO_01.MXD MARTESE 6/15/2011 3:57:33 PM

Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transect
- Site UXO-01 (ASR # 2.79a, b, and c) Boundary
- Jurisdictional Wetland Area

N

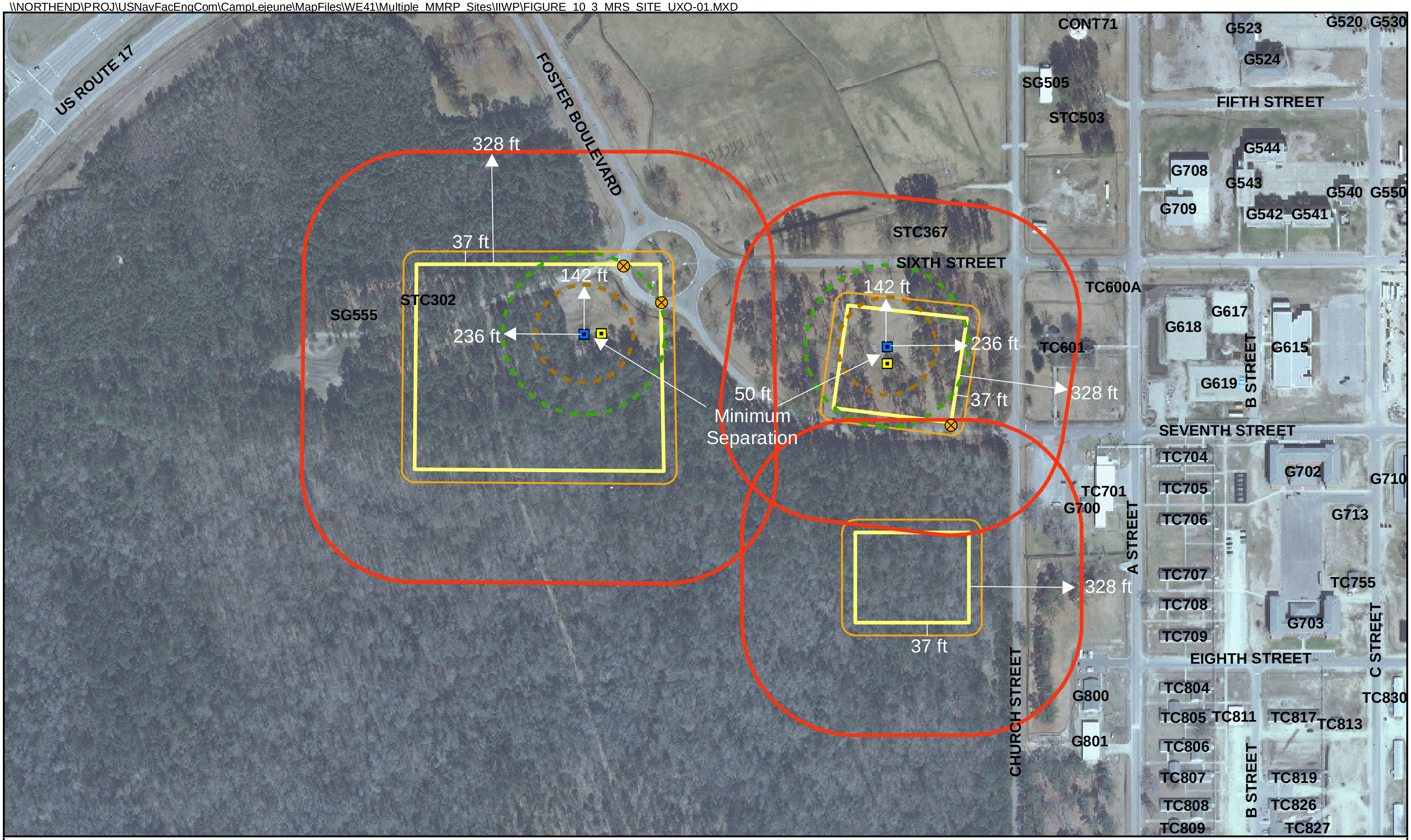
0 75 150 300 Feet

1 inch = 150 feet

Figure 10-2
Digital Geophysical Mapping Results from the PA/SI for UXO-01 (ASR#2.79a,b, and c)
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\FIGURE_10_3_MRS_SITE_UXO-01.MXD



Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point PTR (142 ft)
- MPPEH Collection Point IBD (236 ft)
- Intentional Detonation EZ, All Personnel (328 ft)
- Unintentional Detonation EZ, TSD, Public, and Non-Essential Personnel (37 ft)
- Site UXO-01 (ASR # 2.79a, b, and c) Boundary

N

0 175 350 700 Feet

1 inch = 400 feet (1:4,800)

Figure 10-3
Site UXO-01 (ASR#2.79a,b, and c)
ESQD Arcs for the Primary MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL.

SECTION 11

UXO-02—Former Unnamed Explosive Contaminated Range (ASR #2.201)

11.1 Site Location and Description

Site UXO-02 is a 127-acre area east of Everett Creek Road and adjacent to the New River (**Figure 11-1**). It is accessed by entering the Tactical Landing Zone Owl Gate at Everett Creek Road located on NC Highway 210 immediately south of the Stone Bay Entrance and following the gravel access road. A 14-acre area, Operable Unit (OU) No. 14 Site 69, is located within Site UXO-02.

The site topography ranges from low-lying gently undulating terrain to the north, deeply incised gullies in the south, and steep bluffs bordering the New River. The local topographic high, of roughly 36 feet above mean sea level (msl), lies within the hummocky terrain of Site 69. The vast majority of Site UXO-02 is wooded with some areas supporting dense undergrowth and other areas with a high percent canopy closure and sparse understory. Much of the low-lying area is covered by wetlands that discharge into the New River. An unnamed tributary of the New River is located north of Site 69 and Everett Creek is located south of Site 69. The only cultural features within UXO-02 are the fenced perimeter of Site 69 (installed in the 1990s), a decommissioned power line extending from the fenced perimeter northward, paralleling the New River, and a poorly maintained access trail (suitable for high-clearance vehicles) from Everett Creek Road.

11.2 Site Geology and Hydrogeology

Information derived from the Site UXO-02 PA/SI and other investigations within Site 69 were used to evaluate the site geology. Soil borings from the PA/SI at Site UXO-02 ranged from 7.5 to 20 feet bgs. Although the Site UXO-02 PA/SI only included collection of soil borings from the surficial aquifer, previous investigations, including the Site 69 Supplemental Investigation (CH2MHILL, 2010a) have characterized the geology and hydrogeology to depths of over 200 feet bgs.

Based on the supplemental investigation, previous investigation results, and the UXO-02 PA/SI, geology at Site 69 consists of three distinct geologic formations (undifferentiated sediments, the Belgrade Formation, and the River Bend Formation), which correspond to the surficial aquifer, Castle Hayne confining unit, and Castle Hayne aquifer, respectively. The following is a detailed description of the geologic formations and corresponding aquifer zones:

- <u>Undifferentiated Sediments (surficial aquifer)</u>: Consist mostly of fine grained sand with lesser amounts of clay and silt, extending to a depth of 6 to 18 feet bgs. Sands are light brown or pale brown in color, loose, poorly graded. The undifferentiated formation at Site UXO-02 consists of sediments ranging from clay and silt to very fine- to fine-grained sand. Sediments are predominantly tan, orange, or brown sandy lean clay in the northern portion of the site, grading to silty sand and poorly graded, fine-grained sand with lesser amounts of clayey sand and sandy silt toward the southern areas of the site. In the southern portion of the site, the color of the sediments is typically tan to orange at the shallower depths, with more gray, brown, and black coloration occurring with increasing borehole depth. Monitoring wells screened from 15 to 25 feet bgs are considered to represent conditions within the surficial aquifer.

The water table elevations range from 1.11 to 30.71 feet above msl in March 2010. The groundwater flow directions within the surficial aquifer reflect the topography of Site UXO-02. Radial flow occurs in all directions from Site 69, which encompasses both the highest land surface elevations and surficial aquifer groundwater elevations within site UXO-02. North of Site 69, the groundwater flow direction gradually turns toward northeast and the New River. South of Site 69, the groundwater flow directions converge toward an incised valley (CH2M HILL , 2011a).

Horizontal hydraulic gradients in March 2010 were found to range from 0.0349 ft/ft in the central portion of the site, to 0.255 ft/ft in the vicinity of the bluffs overlooking the New River. The geometric mean hydraulic conductivity for the surficial aquifer at Site UXO-02 is estimated to be 0.662 feet per day (ft/day) (Baker, 2002). In March 2010, the average linear seepage velocity ranged from 0.066 to 0.483 ft/day, using an effective porosity for silty sands of 0.35 (Freeze and Cherry, 1979).

- Belgrade Formation (Castle Hayne confining unit): Consists mostly of moderate to high plasticity silty clays with lesser amounts of sand. The unit is mostly bluish gray. The silty clay unit appears to be laterally continuous across the Site. The unit ranges in thickness from 12 feet near the New River to 30 feet in the central portion of the (CH2MHILL, 2010a).
- River Bend Formation (upper Castle Hayne aquifer): Consists mostly of fine to medium-grained bluish gray sands and silty sand. Abundant shell fragments (mostly bivalves and gastropods), were encountered in the upper River Bend deposits, up to 10 feet thick, but decreased in frequency with depth. Cemented sands were found to occur as laterally discontinuous lenses. This unit ranges in thickness from 18 to 38 feet. Monitoring wells screened from 33 to 75 feet bgs are considered part of the upper Castle Hayne aquifer network. Groundwater elevations in the upper Castle Hayne aquifer, measured in March 2010, ranged from 3.21 feet amsl to 8.88 feet amsl. Groundwater in the upper Castle Hayne aquifer generally flows toward the northeast with an average hydraulic gradient of 0.006 ft/ft (CH2MHILL, 2010a).
- River Bend Formation (marker bed): Consists of a fossiliferous limestone unit that separates the upper and middle Castle Hayne aquifers. This limestone unit is light bluish gray in color with moderate to strong cementation and appears to be laterally continuous across the Site. The limestone unit ranges in thickness from 2 to 8 feet (CH2MHILL, 2010a).
- River Bend Formation (middle Castle Hayne aquifer): Consists mostly of dark greenish gray, fine grained, silty sand with a greater percentage of silt as compared to the upper portion of the River Bend Formation. Monitoring wells screened from 48 to 125 feet bgs are considered part of the middle Castle Hayne aquifer zone. Groundwater elevations

measured in March 2010 ranged from 2.91 feet amsl to 5.00 feet amsl . The direction of groundwater flow appears to be to the northeastern with an average hydraulic gradient of 0.002 ft/ft (CH2MHILL, 2010a).

- River Bend Formation (lower Castle Hayne aquifer): Consists of alternating layers of sand, silt, and limestone, similar to the middle portion of the River Bend Formation. The lower River Bend section was not observed during the SI field effort and limited information is available as only three monitoring wells are screened in the lower Castle Hayne aquifer zone (from 220 to 230 feet bgs). The total depth of the River Bend Formation (and Castle Hayne aquifer) is unknown, as data on geologic conditions deeper than 230 feet bgs are unavailable and a confining or differentiating unit at the bottom of the Castle Hayne aquifer has not been encountered at Site 69. Groundwater elevations measured in March 2010 ranged from 7.57 feet amsl to 7.74 feet amsl. Based on measurements from the three lower Castle Hayne aquifer zone monitoring wells, groundwater flows east with an average hydraulic gradient of 0.001 ft/ft (CH2MHILL, 2010a).

Vertical hydraulic potentials were calculated between the surficial and Castle Hayne aquifers using the water level data measured between adjacent wells screened in the respective aquifers. Based on the March 2010 water-level data, a downward potential exists, ranging from 0.008 to 0.817 ft/ft, between all monitoring well pairs except IR69-GW02DW/ IR69-GW02DD, which has a slight upward potential of 0.0278 ft/ft.

Previous investigations included in-situ aquifer testing (Baker, 1997). The geometric mean hydraulic conductivity calculated for the surficial aquifer was 0.32 feet per day (ft/day) (1.12×10^{-4} centimeters per second [cm/sec]) and the geometric mean for the upper Castle Hayne aquifer was 1.3 ft/day (4.58×10^{-4} cm/sec). These values are consistent with expected values of hydraulic conductivity for the well-sorted fine sands observed at the Site (Fetter, 1986).

In 1994, Baker calculated a linear seepage velocity for the surficial aquifer to be 0.06 ft/day (approximately 22 feet per year [ft/year]). The upper Castle Hayne aquifer zone linear seepage velocity had a geometric mean of 0.03 ft/day (approximately 11 ft/year), using an effective porosity (n_e) value 0.33 for fine sands.

11.3 Site History and Previous Investigations

11.3.1 History

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

Installation Restoration (IR) Site 69, the Rifle Range Chemical Dump, a 14-acre area within Site UXO-02, was first identified in the 1983 Basewide Initial Assessment Study (IAS) as a priority site for further investigation based on historical disposal activities. From 1950 to 1976, Site 69 was reportedly used for the disposal of chemical wastes, including polychlorinated biphenyls (PCBs), solvents, and pesticides. Based on available documentation, Site 69 may also have a history of CWM disposal. Discarded M9 CA detector kits were observed during a 1982 site visit (Water and Air Research, 1983). Formal documentation of disposal methods, particularly related to CWM, is unavailable. The disposal incident allegedly occurred in 1953 or 1954 when approximately 50 to 60 drums of suspected training agent were reportedly delivered to the Site and disposed of in two trenches, each approximately 20 feet deep. A second disposal incident occurred in 1970 when 5-gallon cans and 55-gallon drums of dichlorodiphenyltrichloroethane (DDT), trichloroethene (TCE), and calcium hypochlorite were placed together in a common pit. An explosion occurred as soil was being placed over the containers, causing a brush fire and the ejection of drums as far as 120 feet from the pit (Water and Air Research, 1983). Historical information and previous investigations have been focused on Site 69; no known investigations have been conducted in other areas of Site UXO-02.

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

11.3.2 Site 69 Supplemental Investigation

A supplemental investigation of Site 69 was conducted in February and March 2010 to refine the nature and extent of impacted media (CH2M HILL, 2010a).

Field activities included: a geophysical investigation to assess the extent of buried debris; the collection of surface and subsurface soil samples around the perimeter of the fenced portion of Site 69; the collection of surface water and sediment samples in drainage features to the north and south of the Site; the installation of downgradient and side-gradient monitoring wells screened in the upper Castle Hayne and middle Castle Hayne aquifers; and the collection of groundwater samples from new and existing monitoring wells screened in the surficial, upper- , middle-, and lower-Castle Hayne aquifers. All samples were analyzed for volatile organic compounds (VOCs), SVOCs, pesticides, PCBs, and metals. During field sampling activities, Edgewood Chemical Biological Center (ECBC) monitored and screened for the presence of CA; however, CA was not encountered. **Figures 11-2** and **11-3** illustrate the frequency and location of exceedances of regulatory or screening criteria in surface soils and sediment, respectively.

Potential risks associated with future residential and industrial worker ingestion of groundwater from the surficial and upper Castle Hayne aquifers were found to be greater than the USEPA's acceptable risk range and hazard level. The primary COCs contributing to the elevated risk in the surficial aquifer groundwater are VC, iron, and manganese. The primary COCs contributing to elevated risk from groundwater in the upper Castle Hayne aquifer are vinyl chloride (VC), chromium, 1,2-DCA, aroclor-1260, and heptachlor epoxide. The residential and industrial land use scenarios evaluated are very conservative, as land use controls (LUCs) are in-place to prevent intrusive activities and non-industrial use of groundwater within Site 69.

During the ERA, pesticides in soil and sediment were identified as posing a risk to lower trophic level receptors, but not to upper trophic level receptors. Although upper trophic level receptors were not identified at risk from pesticides, the data set for sediments was limited to only three samples. In surface soil, 4,4,-DDE, 4,4′-DDT, alpha-beta hexachloride (alpha-BHC), beta-BHC, and mercury all had hazard quotients (HQs) greater than 1 but less than 2, and are not expected to pose significant risks to lower trophic level receptors at the Site. Endrin and gamma-BHC (lindane) were retained for further consideration. In sediment, the pesticides 4,4′-DDD, 4,4′-DDE, 4,4′-DDT, alpha-chlordane, dieldrin, endosulfan I, endosulfan sulfate, endrin, gamma-BHC (lindane), heptachlor, and methoxychlor all had HQs above 1.

In addition, potential risks to lower trophic level receptors from pesticide exposure to groundwater discharging to the surface were identified. The pesticides contributing to the elevated risk include 4,4′-DDD, 4,4′-DDE, 4,4′-DDT, alpha-chlordane, dieldrin, endosulfan I, endosulfan sulfate, endrin, gamma-BHC (lindane), heptachlor, and methoxychlor.

The supplemental investigation recommended completion of a feasibility study. Included were recommendations to conduct intrusive investigation to assess the nature of identified geophysical anomalies outside of the Site 69 boundary and recommendations to complete additional risk assessment. The specific recommendations included the completion of Step 3b (problem formulation development) to evaluate the distribution of pesticides, the potential for Site 69 to be the source of pesticides found in the downgradient areas, and their potential toxicity to site receptors.

Step 3b was completed during the development of this work plan. The complete evaluation is provided in **Appendix F**; the conclusions are summarized in the following paragraphs.

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

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

Additional sediment sampling is necessary for all the organochlorine pesticides, because multiple analytes were considered to pose potential risk in sediments. It is also necessary to analyze for monocrotophos, an organophosphate pesticide. Sediments samples will be analyzed for total organic carbon (TOC) in order to estimate concentrations of pesticides in pore water that is equilibrium with the sediment, if necessary. Organic carbon can bind the pesticides, making them less available to many receptors, and the estimated pesticide concentrations in pore water can then be compared to benchmarks derived for surface water.

11.3.3 PA/SI

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

A DGM survey completed in February 2010 using a single-coil EM61-MK2 system covered approximately 10 percent (11.3 acres) of Site UXO-02. A total of 1,457 geophysical anomalies were identified . Approximately 21 percent of the detected anomalies (308 of the 1,457 total anomalies) were observed to be either cultural items or signal noise. The cultural items were associated with debris from roadways, power lines, or other trash/debris. A total of 1,149 anomalies were identified as representing potential subsurface MEC (CH2M HILL, 2011a). **Figure 11-4** illustrates the DGM area and the distribution of anomalies representing potential subsurface MEC.

Anomalies were present throughout the site, with localized clustering in three areas: (1) the northern section, possibly associated with the washing of cultural debris (unrelated to military activities) or military materiel inland from Stone Bay during times of elevated water levels, (2) along the roadway that extends along the southern edge of Site UXO-02, and (3) a trash site in the southeastern section where a metallic drum was observed on the surface in this area.

Environmental sampling for the 2010 PA/SI was limited to potential MC analysis and included:

- 205 surface soil samples (0-2 inches bgs) collected from Site UXO-02 using the TR-02-1 approach.
- One unsaturated subsurface soil sample collected at each of 31 soil borings at a depth immediately above the estimated water table.
- Groundwater samples collected from each of the 28 temporary monitoring wells in UXO-02 and from 7 existing monitoring wells within the fenced perimeter of Site 69.
- Ten surface water and sediment samples each collected at co-located sites.

All samples were analyzed for explosives residues including PETN and nitroglycerin (USEPA SW-846 Method 8330), perchlorate (SW-846 USEPA Method 6850), and TAL metals (SW-846 USEPA Method 6010B and 7471A). Additional analyses for dissolved metals (SW-846 USEPA Method 6010B) were conducted for surface water samples and groundwater samples collected from 20 of the temporary monitoring wells within UXO-02, and from the 7 pre-existing wells located within the fenced area of Site 69.

The human health risk evaluation for Site UXO-02 concluded that exposure to surface soil and surface water at Site UXO-02 is not expected to result in unacceptable human health risks. In subsurface soil, sediment, and groundwater, the 95% UCL of the mean concentration resulted in a cumulative carcinogenic risk greater than the screening criteria, however, chromium was the main contributor to the carcinogenic risk associated with each media. Groundwater samples exceeding screening levels are shown on **Figure 11-5**. The analytical data for chromium are for total chromium; however, the RSL used for the screening was for hexavalent chromium, the more toxic (and carcinogenic) form as compared to trivalent chromium. In the past, prior to including the New Jersey EPA oral cancer slope factor for hexavalent chromium in the table, USEPA's Regional Screening Level (RSL) table presented a residential soil RSL for total chromium assuming a 1 to 6 ratio of hexavalent chromium to trivalent chromium. Assuming this ratio applies to subsurface soil, sediment, and groundwater, exposure to subsurface soil, sediment, and groundwater at Site UXO-02 were not expected to result in unacceptable human health risks.

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

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

The report recommended that the 1,149 anomalies potentially representing subsurface MEC be investigated, that groundwater conditions should be additionally investigated under the ongoing Site 69 investigation, and that additional assessment of MC should be re-evaluated upon completion of the recommended intrusive investigation of geophysical anomalies (CH2M HILL, 2011a).

11.4 Field Activities

11.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

11.4.2 Environmental Sampling and Analysis

This work plan is intended to also address Step 4 of the ERA process, which is the BERA Work Plan. Data quality objectives have been developed for each of the proposed surface soil and sediment samples (**Appendix F**). Immediately prior to sampling, a site review will be conducted to confirm that the sample locations shown on the figures in this work plan are appropriate and will meet the objectives of the study. This is referred to as Step 5 of the ERA process, field sampling plan verification. Proposed changes based on field verification will be communicated to the CamLej Partnering Team. Surface soil, sediment, and groundwater sampling will be conducted within Site UXO-02 as follows:

Surface Soil Sampling

Six surface soil samples will be collected using the TR-02-1 sampling method (refer to **Section 3.4**). Approximate sampling locations are shown on **Figure 11-6**. The location of each sample may be adjusted to a field-suitable location (for example, to a location free of poison ivy). The actual coordinates of the sampling locations will then be logged into the GPS and will be based on the center of the sampling area.

Surface soil samples will be analyzed for the organochlorine pesticides endrin and gamma-BHC (USEPA Method SW-846 8081B) at a fixed-base laboratory (**Table 11-1**).

Sediment Sampling

Up to twelve sediment samples will be collected from surface water drainage areas across Site UXO-02, with nine pre-planned sampling locations, as shown on **Figure 11-6**. In addition, two background and up to three discretionary sample locations will be identified during a preliminary field reconnaissance. Sediment will be collected using a clean trowel and bowl, drained of excess water, and placed into the appropriate sample containers. Sediment samples will be analyzed for organochlorine pesticides and monocrotophos (USEPA Methods SW-846 8081B and 8141A), and TOC (Walkley Black method) at a fixed base laboratory (**Table 11-1**).

Well Installation and Groundwater Sampling

Permanent groundwater monitoring wells will be installed in five locations via hollow stem auger, as shown on **Figure 11-7.** Each well will consist of 2-inch inner diameter polyvinyl chloride (PVC) well casing, with a 10-foot section of 0.010-inch machine-slotted well screen. The screen will be connected to a new, threaded, flush-jointed, PVC riser casing with the O-rings removed prior to assembly. Wells will be secured with steel, above grade surface completions, and locking caps. The wells will be constructed in accordance with *Installation of Shallow Monitoring Wells* SOP in **Appendix C** of the MRP MPPs (CH2M HILL, 2008a). Optimally, the static groundwater table will intersect 1 to 2 feet below the top of the screen of each monitoring well so that 8 to 9 feet of the screen is below the water.

The monitoring wells will be developed by the drilling subcontractor to reduce turbidity and allowed to equilibrate to ambient aquifer conditions before static groundwater elevation measurements and environmental groundwater sampling activities begin.

Static groundwater elevations will be measured in the five newly installed monitoring wells and all existing UXO-02 surficial aquifer monitoring wells located outside of the Site 69 fence prior to initiating groundwater sampling at any monitoring well. The static water levels will be measured using an electronic water level indicator. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot. The indicator will be decontaminated after use in each well.

TABLE 11-1
Summary of Surface Soil and Sediment Sampling and Analysis Program at UXO-2

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis	
			Organochlorine Pesticides*	**Monocrotophos**
Surface Soil	MR02-SS185-11B through MR02-SS190-11B	TR-02-01 methodology will be used to collect soil from 0 – 2 inches bgs. Will allow for characterization of the nature and extent of endrin and gamma-BHC in surface soil and support additional ecological risk screening	6	0
Sediment	MR02-SD11-11B through MR02-SD22-11B	Incremental sampling methodology will be used to collect soil outside of the crater from 0 – 2 inches bgs. Will allow for characterization of the nature and extent of pesticides in surface soil and support additional ecological risk screening	12	12

* Analysis in surface soil is only for two organochlorine pesticides: endrin and gamma-BHC.

Groundwater samples will be collected from each new well and five existing wells using a peristaltic or bladder pump and low-flow purge rates in accordance with the Low-Flow Groundwater Sampling from Monitoring Wells SOP in Appendix C of the MRP MPPs (CH2M HILL, 2008a).

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

Samples will be analyzed by a fixed base laboratory for the following parameters (**Table 11-2**):

- Total TAL metals including mercury (EPA SW-846 Method 6010C and 7470A)

Three samples (from monitoring wells in proximity to surface water bodies) will also be analyzed for:

- Dissolved TAL metals including mercury (EPA SW-846 Method 6010C series and 7470A)
- Dissolved Hexavalent chromium (EPA SW-846 Method 7196A)

11.4.3 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the UFP-SAP (**Appendix B**).

11.4.4 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-02 will include reacquisition and investigation of 1,149 anomalies that were identified as during the PA/SI as representing potential subsurface MEC (**Figure 11-4**). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission

The intrusive investigation at Site UXO-02 will be conducted in accordance with the Base-wide ESS (CH2M HILL, 2011d). Intrusive investigation activities will not be conducted until approval of the ESS is received from MARCORSYSCOM.

Operations in Populated and Sensitive Areas

Site UXO-02 is not located in a populated area. Sensitive habitats include jurisdictional wetlands in portions of UXO-02. In addition, the endangered Red-cockaded woodpecker and rough-leaved loosestrife may be present at Site UXO-02. MEC operations in these areas will be conducted in accordance with the EPP (**Section 8**) to be protective of these sensitive areas and all threatened and endangered species.

Exclusion Zones and Separation Distances

The primary MGFD for the site is the 81mm mortar, M43. The contingency MGFD is the 155mm, M107, Composition B Filled**.** Exclusion zone parameters are provided on **Table 11-3** and are shown on **Figure 11-8.**

TABLE 11-2
Summary of Groundwater Sampling and Analysis Program at UXO-02

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis	
			TAL Metals	Hexavalent Chromium
Unfiltered Groundwater	MR02-IR69-GW09-11B, MR02-IR69-GW11-11B through MR02-IR69-GW14-11B MR02-GW01-11B through MR02-GW05-11B	Low-flow purge methodology will be used to collect groundwater samples. Will allow for the measurement of total metals concentrations in low turbidity groundwater samples	10	0
Filtered Groundwater	MR02-GWXX*-11B	Low-flow purge methodology will be used to collect groundwater samples and the samples will be filtered in the field. Will allow for the measurement of dissolved metals concentrations in groundwater that may discharge to surface water	3	3

Notes and Abbreviations:

XX = three permanent monitoring well to be determined based on proximity to surface water

TABLE 11-3
Exclusion Zone Parameters for Site UXO-02

Operation	Sited as	Exposed Site (ES)	Basis	ESQD[1] (feet)
Primary MGFD (81mm M43)				
Manual operations[2]	Unintentional detonation	UXO teams	K40 of the MGFD	43
Manual operations[2]	Unintentional detonation	Public and non-essential personnel	HFD of the MGFD	209
MEC treatment up to 20 lb NEW[3]	Intentional detonation	Public and all personnel	MFD of the MGFD	1579[4]
Contingency MGFD (155mm M107 Composition B Filled)				
Manual operations[2]	Unintentional detonation	UXO teams	K40 of the MGFD	105
Manual operations[2]	Unintentional detonation	Public and non-essential personnel	HFD of the MGFD	450
MEC treatment up to 20 lb NEW[3]	Intentional detonation	Public and all personnel	MFD of the MGFD	2630[4]
MPPEH Collection				
MPPEH collection area for onsite consolidation, storage, and re-inspection (up to 2 lb NEW)[5]	Metal Storage Container (e.g., 55-gallon drum or CONEX box)	Non-essential personnel in structures	Inhabited Building Distance (IBD)[6]	346
		Non-essential personnel in the open	Public Transportation Route (PTR)[6]	260

Table notes:
1. From Fragmentation Data Review Form, Updated 15 April 2011.
2. Manual operations involve excavating anomalies with hand tools.
3. The K328 of the MEC treatment may not exceed the MFD-H of the MGFD. Operations will be limited to 20 lb MEC treatment for consolidated shots. For 20 lb, the K328 distance equals 890 feet which is less than the MFD-H of 1579 feet for the primary MGFD and 2630 feet for the contingency MGFD. The K328 distance is calculated using the formula $D=328*W^{(1/3)}$.
4. This distance can be reduced by employing engineering controls authorized by DDESB TP-16.
5. MPPEH storage allows storage of individual items up to 2 lb NEW.
6. Based on Table 7-9, Ordnance Publication (OP)-5, Volume 1, 7th Revision (NAVSEA, 2010). PTR is 60 percent of IBD.

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

Legend

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

N

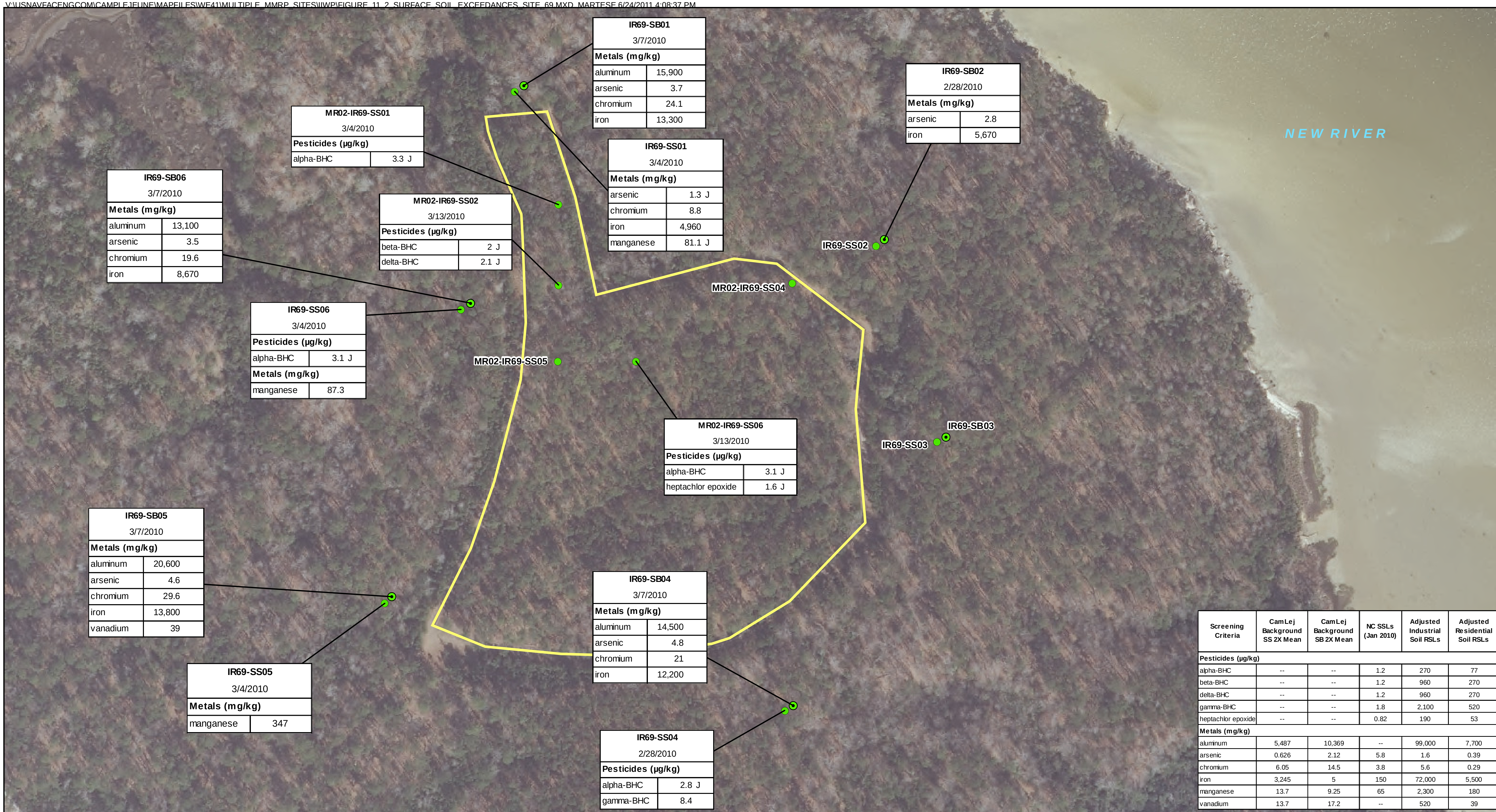
0 750 1,500 Feet

1 inch = 1,500 feet

Figure 11-1
UXO-02 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_2_SURFACE_SOIL_EXCEEDANCES_SITE_69.MXD MARTESE 6/24/2011 4:08:37 PM



IR69-SB01	
3/7/2010	
Metals (mg/kg)	
aluminum	15,900
arsenic	3.7
chromium	24.1
iron	13,300

IR69-SB02	
2/28/2010	
Metals (mg/kg)	
arsenic	2.8
iron	5,670

MR02-IR69-SS01	
3/4/2010	
Pesticides (µg/kg)	
alpha-BHC	3.3 J

IR69-SS01	
3/4/2010	
Metals (mg/kg)	
arsenic	1.3 J
chromium	8.8
iron	4,960
manganese	81.1 J

IR69-SB06	
3/7/2010	
Metals (mg/kg)	
aluminum	13,100
arsenic	3.5
chromium	19.6
iron	8,670

MR02-IR69-SS02	
3/13/2010	
Pesticides (µg/kg)	
beta-BHC	2 J
delta-BHC	2.1 J

IR69-SS06	
3/4/2010	
Pesticides (µg/kg)	
alpha-BHC	3.1 J
Metals (mg/kg)	
manganese	87.3

MR02-IR69-SS06	
3/13/2010	
Pesticides (µg/kg)	
alpha-BHC	3.1 J
heptachlor epoxide	1.6 J

IR69-SB05	
3/7/2010	
Metals (mg/kg)	
aluminum	20,600
arsenic	4.6
chromium	29.6
iron	13,800
vanadium	39

IR69-SB04	
3/7/2010	
Metals (mg/kg)	
aluminum	14,500
arsenic	4.8
chromium	21
iron	12,200

IR69-SS05	
3/4/2010	
Metals (mg/kg)	
manganese	347

IR69-SS04	
2/28/2010	
Pesticides (µg/kg)	
alpha-BHC	2.8 J
gamma-BHC	8.4

Screening Criteria	CamLej Background SS 2X Mean	CamLej Background SB 2X Mean	NC SSLs (Jan 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Pesticides (µg/kg)					
alpha-BHC	--	--	1.2	270	77
beta-BHC	--	--	1.2	960	270
delta-BHC	--	--	1.2	960	270
gamma-BHC	--	--	1.8	2,100	520
heptachlor epoxide	--	--	0.82	190	53
Metals (mg/kg)					
aluminum	5,487	10,369	--	99,000	7,700
arsenic	0.626	2.12	5.8	1.6	0.39
chromium	6.05	14.5	3.8	5.6	0.29
iron	3,245	5	150	72,000	5,500
manganese	13.7	9.25	65	2,300	180
vanadium	13.7	17.2	--	520	39

Legend
- Surface Soil Sampling Locations
- Subsurface Soil Sampling Locations
- Site 69

Notes:
Analytical exceedances from the Site 69 Supplemental Investigation
J- Analyte present, value may or may not be accurate or precise
mg/kg - milligrams per kilogram
µg/kg -micrograms per kilogram
NC SSLs - NCDENR Soil Screening Levels
RSLs - USEPA Regional Screening Levels
SS - Surface Soil
SB - Subsurface Soil
BHC - Benzene Hexachloride

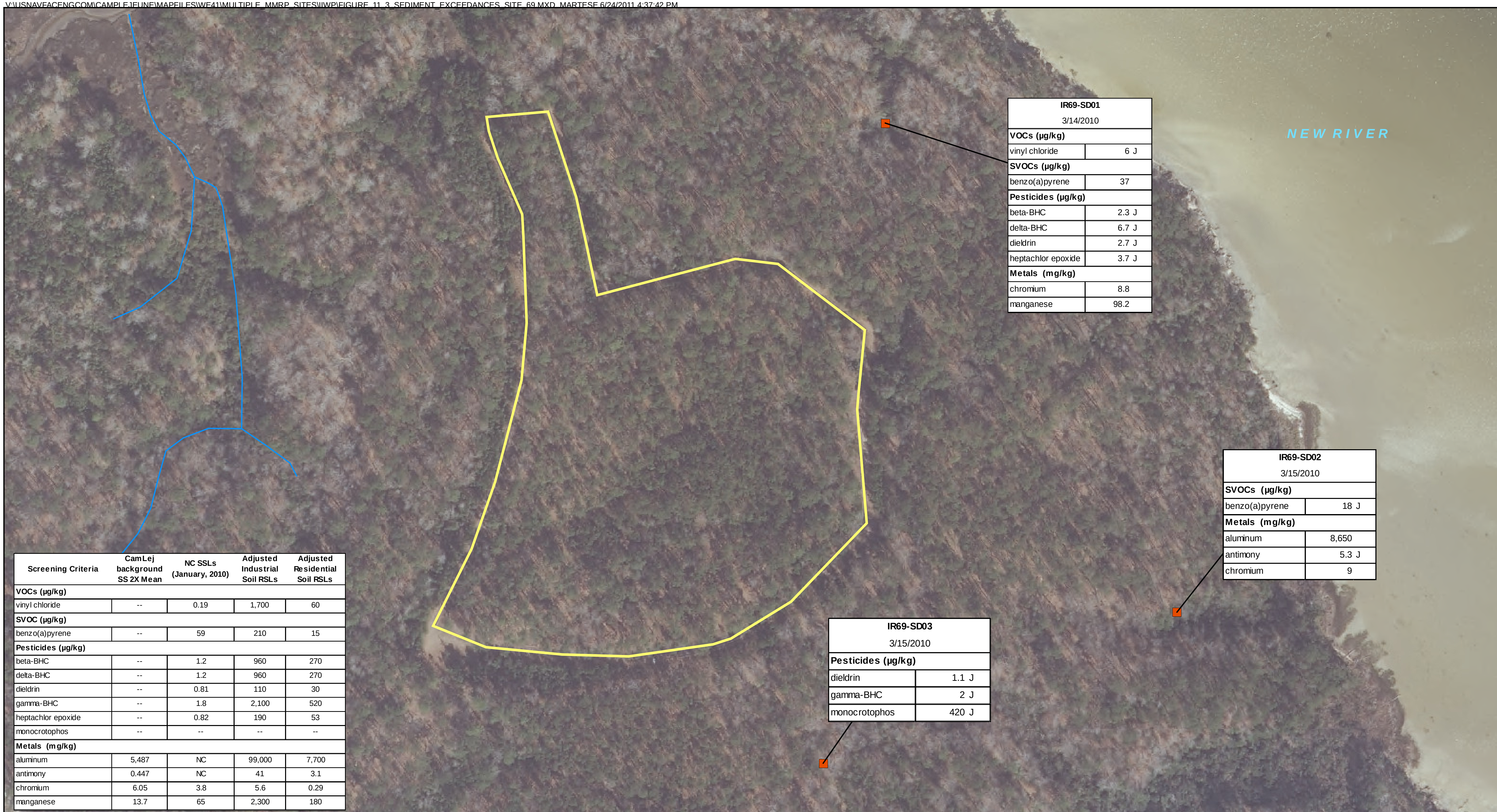
N

0 100 200 400 Feet

1 inch = 200 feet

Figure 11-2
Site UXO-02 Surface Soil Exceedances
Multiple MMRP Sites
Intrusive Investigation Work Plan
MCB CamLej
North Carolina

CH2MHILL



IR69-SD01	
3/14/2010	
VOCs (µg/kg)	
vinyl chloride	6 J
SVOCs (µg/kg)	
benzo(a)pyrene	37
Pesticides (µg/kg)	
beta-BHC	2.3 J
delta-BHC	6.7 J
dieldrin	2.7 J
heptachlor epoxide	3.7 J
Metals (mg/kg)	
chromium	8.8
manganese	98.2

IR69-SD02	
3/15/2010	
SVOCs (µg/kg)	
benzo(a)pyrene	18 J
Metals (mg/kg)	
aluminum	8,650
antimony	5.3 J
chromium	9

IR69-SD03	
3/15/2010	
Pesticides (µg/kg)	
dieldrin	1.1 J
gamma-BHC	2 J
monocrotophos	420 J

Screening Criteria	CamLej background SS 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
VOCs (µg/kg)				
vinyl chloride	--	0.19	1,700	60
SVOC (µg/kg)				
benzo(a)pyrene	--	59	210	15
Pesticides (µg/kg)				
beta-BHC	--	1.2	960	270
delta-BHC	--	1.2	960	270
dieldrin	--	0.81	110	30
gamma-BHC	--	1.8	2,100	520
heptachlor epoxide	--	0.82	190	53
monocrotophos	--	--	--	--
Metals (mg/kg)				
aluminum	5,487	NC	99,000	7,700
antimony	0.447	NC	41	3.1
chromium	6.05	3.8	5.6	0.29
manganese	13.7	65	2,300	180

Legend

- Sediment Sampling Locations
- Surface Water
- Site 69

Notes:
Analytical exceedances from the Site 69 Supplemental Investigation
J- Analyte present, value may or may not be accurate or precise
mg/kg - milligrams per kilogram
µg/kg -micrograms per kilogram
NC SSLs - NCDENR Soil Screening Levels
RSLs - USEPA Regional Screening Levels
SVOC - semi-volatile organic compound
VOC - volatile organic compound
BHC - Benzene Hexachloride
NC - no screening criteria established

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 11-3
Site UXO-02 Sediment Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_4_DIGITAL_GEOPHYSICAL_MAPPING_RESULTS_UXO_02.MXD MARTESE 6/27/2011 8:25:39 AM

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

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 11-4
Site UXO-02 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_5_GROUNDWATER_METALS_EXCEEDANCES_PA_SI_UXO_02.MXD MARTESE 6/27/2011 8:37:13 AM

Legend

Site UXO-02 Boundary

Site 69

Exceedances

2X Mean Base Background and NCGWQS

2X Mean Base Background and Adjusted Tap Water RSL

Note:
Analytical exceedances from the PA/SI

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 11-5
Site UXO-02 Metal Exceedances in Groundwater
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_6_SURFACE_SOIL_AND_SD_SAMPLE_LOCATIONS_UXO_02.MXD MARTESE 6/27/2011 8:48:23 AM

Legend

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

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 11-6
Site UXO-02 Surface Soil and Sediment Sampling Locations
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_7_GW_SAMPLING_LOCATIONS_UXO_02.MXD MARTESE 6/27/2011 12:44:58 PM

Legend

- Proposed Monitoring Well (Surficial Aquifer)
- Existing Monitoring Well (Surficial Aquifer)
- Potentiometric Contour
- Groundwater Flow Direction
- Site UXO-02 Boundary
- Site 69 Boundary

Note: Potentiometric surface contours have been inferred beween temporary well locations. Actual conditions may differ from those shown here.
28 - groundwater elevation in feet above mean sea level
Water levels gauged March 2010

N

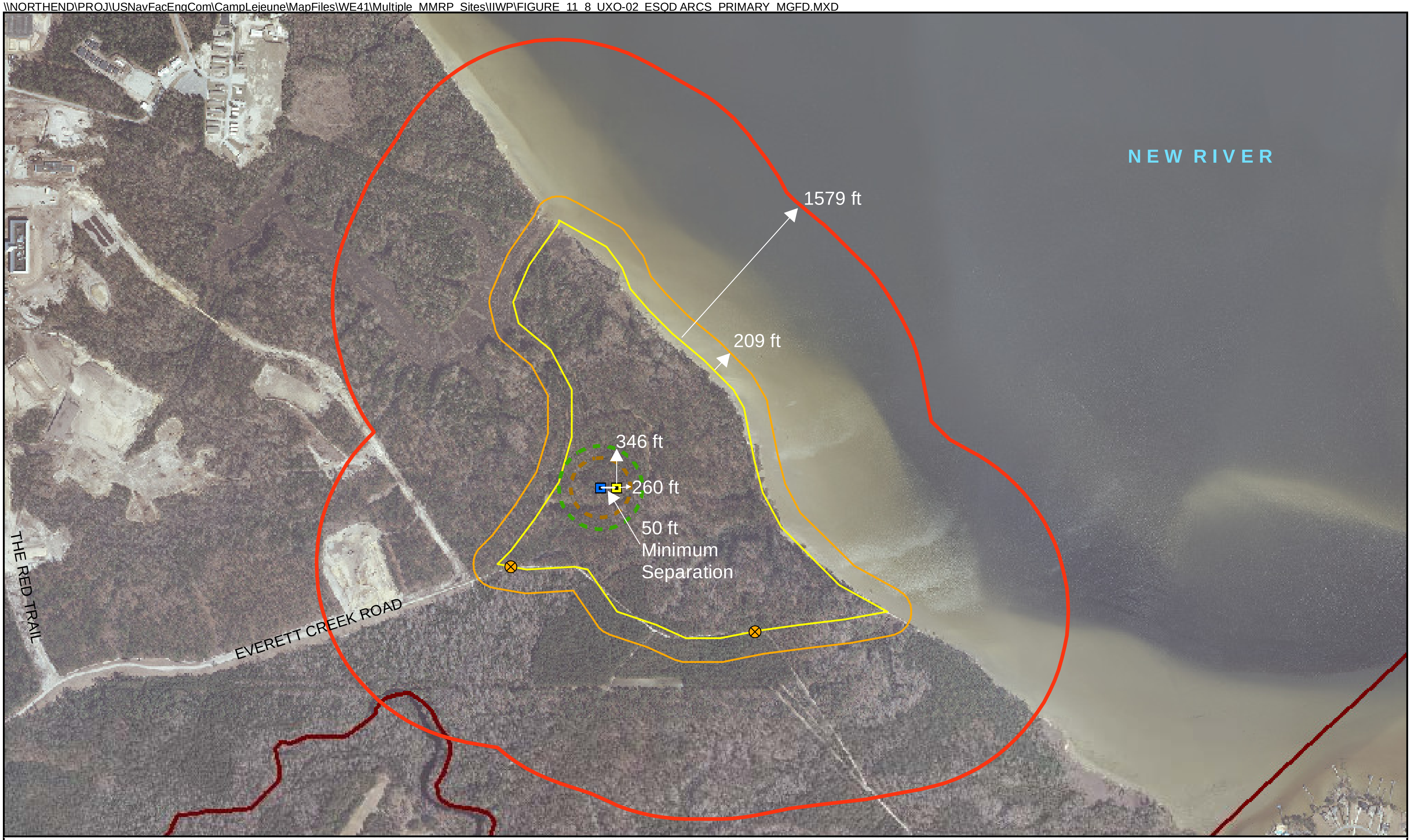
0 175 350 700 Feet

1 inch = 350 feet

Figure 11-7
Site UXO-02 Groundwater Sampling Locations
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\FIGURE_11_8_UXO-02_ESQD ARCS_PRIMARY_MGFD.MXD



Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point IBD (346 ft)
- MPPEH Collection Point PTR (260 ft)
- Intentional Detonation EZ, All Personnel (1579 ft)
- Unintentional Detonation EZ, Public, and Non-Essential Personnel (209 ft)
- Installation Boundary
- Site UXO-02 Boundary

N

0 600 1,200 2,400 Feet

1 inch = 1,200 feet (1:14,400)

Figure 11-8
Site UXO-02
ESQD Arcs for the Primary MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\FIGURE_11_9_UXO-02_ESQD ARCS_CONTINGENCY_MGFD.MXD

Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point IBD (346 ft)
- MPPEH Collection Point PTR (260 ft)
- Intentional Detonation EZ, All Personnel (2630 ft)
- Unintentional Detonation EZ, Public, and Non-Essential Personnel (450 ft)
- Site UXO-02 Boundary
- Installation Boundary

N

0 750 1,500 3,000 Feet

1 inch = 1,500 feet (1:18,000)

Figure 11-9
Site UXO-02
ESQD Arcs for the Contingency MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL.

SECTION 12

UXO-07—Former Practice Hand Grenade Course (ASR #2.77a and #2.77b)

12.1 Site Location and Description

Site UXO-07 includes two separate areas located south of the intersection of McHugh Boulevard and O Street in the Hadnot Point area of “Mainside” MCB CamLej (**Figure 12-1**). The northern area of the site is approximately 5 acres in size and includes buildings HP502, HP503, and SHP499, surrounding parking and grassy areas, and a surface water drainage feature. The southern area is located immediately north of Building HP500, is approximately 2 acres in size, and includes a parking lot and grassy areas. Most of the site is cleared and/or developed with a parking lot and buildings, with the exception of a small forested area in the northeast corner of the site.

The majority of the area surrounding Site UXO-07 is developed and supports buildings, parking lots, and other infrastructure. Approximately one-quarter of the immediate area southeast of Site UXO-07 includes woodlands or recreational fields. The woodlands include jurisdictional wetlands and surround an unnamed tributary of French Creek, which is located approximately 1 mile southeast of Site UXO-07. French Creek in turn discharges into the New River downstream of the site.

12.2 Site Geology and Hydrogeology

Soil cores inspected as part of the PA/SI for Site UXO-07 indicated that the sediments between ground surface and depths up to 25 ft bgs consist of poorly graded, fine-grained sand interbedded with a lesser amount of clayey sands/sandy clays (CH2M HILL, 2010b). These shallow sediments are consistent with those of the undifferentiated formation.

The water table of the surficial aquifer occurs in the undifferentiated formation at this site. Site-specific hydrogeologic information was derived from the installation of six shallow temporary monitoring wells during the PA/SI. The temporary wells were screened in the undifferentiated surficial aquifer. The depth to surficial groundwater ranged from 6.91 to 3.91 feet above msl at the site during the December 2009 investigation. The potentiometric surface of the water table in December 2009 indicated that groundwater mimics surface topography and generally flows to the south. Horizontal hydraulic gradients ranged from a minimum of 0.00003 in the southwestern end of the site to a maximum of 0.008 ft/ft in the northeastern portion of the site. (CH2M HILL, 2010b).

12.3 Site History and Previous Investigations

12.3.1 History

CH2M HILL completed an Archival Records Search Report for this site as part of the PA/SI (CH2M HILL, 2010b). Historical maps show that prior to 1953 the area of investigation was used as a recreational facility, which included baseball and softball fields. According to the *Range Identification and Preliminary Range Assessment (*USACE, 2001), munitions were used at the D-6 Practice Hand Grenade Course from 1953 until approximately 1959, and included fuses and practice hand grenades.

The area of Site UXO-07 closest to McHugh Boulevard appears to have remained as recreational fields from the 1950s through the 1980s, while the southern area was primarily wooded. As shown on a 1984 existing conditions map (CH2M HILL , 2010b), the southern area of Site UXO-07 appears to overlap the Former 5th Area Gun Park. This gun park was a large parking area with concrete pads and small sheds where 105-mm and 155-mm howitzers of the 10th Marines (Artillery Regiment) were stored along with the trucks that towed the howitzers. The sheds were also used to perform maintenance and store equipment for the howitzers (Richardson, 2007). Historical aerial photographs indicate that by 1989 the northern portion had been developed and looked very similar to current conditions. Building HP503 (shown on **Figure 12-1**) in the northern area had not yet been constructed in 1989.

12.3.2 PA/SI

A PA/SI was conducted in 2009 for Site UXO-07 to evaluate the potential presence and nature of effects on environmental media resulting from historical munitions use at the site, and to determine whether additional investigation and/or remediation activities were necessary. The DGM survey using a single-coil EM61-MK2 system in May 2009 covered 11.7 percent (approximately 0.82 acre) of Site UXO-07. The DGM survey yielded a total of 1,433 geophysical anomalies. Of this total, 315 anomalies (22 percent) were determined to be cultural items associated with power lines, buildings, active parking lots, subsurface utilities, and chain link fences. The remaining 1,118 anomalies were selected as representing potential subsurface MEC (CH2M HILL, 2010b). The greatest density of anomalies was found near roads and buildings, including the Armory located in the southwest corner of the site. **Figure 12-2** illustrates the DGM area and the distribution of anomalies identified as representing potential subsurface MEC.

Environmental sampling for MC analysis within Site UXO-07 consisted of:

- Forty-two surface soil samples collected using the TR-02-1 approach at a depth interval of 0 to 2 inches bgs
- One unsaturated subsurface soil sample was collected at each of 17 soil boring locations at a depth immediately above the estimated water table.
- Two surface water and two sediment samples collected at co-located sites from an unnamed drainage feature in the northern portion of the site
- Six groundwater samples collected from temporary groundwater monitoring wells.

Surface soil, subsurface soil, sediment, surface water, and groundwater samples were analyzed for: explosives residues, including PETN and nitroglycerin (by SW-846 USEPA Method 8330), perchlorate (by SW-846 USEPA Method 6850), and TAL metals (aluminum, antimony, arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, sodium, vanadium, and zinc by SW-846 USEPA Method 6010B and 7471A). Groundwater samples were additionally analyzed for dissolved metals by the same SW-846 methods. Because no unacceptable human health or ecological risks were identified from exposure to site media, no further environmental characterization sampling was recommended.

Based on the DGM results, the PA/SI report recommended that an intrusive investigation be performed to assess the nature of the identified geophysical anomalies. The need for additional sampling for MC could be re-evaluated based on the results of the intrusive anomaly investigation.

12.4 Field Activities

12.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

12.4.2 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the QAPP (**Appendix C**).

12.4.3 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-07 will include reacquisition and investigation of 1,133 anomalies that were identified during the PA/SI as representing potential subsurface MEC (**Figure 12-2**). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission

The intrusive investigation at Site UXO-07 will be conducted in accordance with the Base-wide ESS (CH2M HILL, 2011d). Intrusive investigation activities will not be conducted until approval of the ESS is received from MARCORSYSCOM.

Operations in Populated and Sensitive Areas

Site UXO-07 is located in a populated area. Site UXO-07 contains industrial buildings and parking lots used by Base personnel, as well as a major thoroughfare, O Street. An EZ Enforcement Plan will be developed in coordination with Base facility personnel to guide enforcement of the EZ during intrusive and controlled detonation activities in these populated areas.

No jurisdictional wetlands or habitat for threatened or endangered species are located within the site.

Exclusion Zones and Separation Distances

The primary MGFD for the site is the hand grenade M204 fuze. The contingency MGFD is the MII hand grenade. Exclusion zone parameters are provided on **Table 12-1** and are shown on **Figures 12-3** (for the primary MGFD) **and 12-4** (for the contingency MGFD).

TABLE 12-1
Exclusion Zone Parameters for Site UXO-07

Operation	Sited as	Exposed Site (ES)	Basis	ESQD[1] (feet)
Primary MGFD (Hand Grenade M204 Fuze)				
Manual operations[2]	Unintentional detonation	UXO teams	K40 of the MGFD	6
Manual operations[2]	Unintentional detonation	Public and non-essential personnel	HFD of the MGFD	7
MEC treatment up to 1 lb NEW	Intentional detonation	Public and all personnel	K328 of 1 lb NEW[3]	328[3, 4]
Contingency MGFD (Mk II Grenade)				
Manual operations[2]	Unintentional detonation	UXO teams	K40 of the MGFD	33
Manual operations[2]	Unintentional detonation	Public and non-essential personnel	HFD of the MGFD	62
MEC treatment up to 2 lb NEW[5]	Intentional detonation	Public and all personnel	MFD of the MGFD	521[4]
MPPEH Collection Areas				
MPPEH collection area for onsite consolidation, storage, and re-inspection (up to 0.5 lb NEW)[6]	Metal Storage Container (e.g., 55-gallon drum or CONEX box)	Non-essential personnel in structures	Inhabited Building Distance (IBD)[7]	236
		Non-essential personnel in the open	Public Transportation Route (PTR)[7]	142

Table notes:
1. From Fragmentation Data Review Form, Updated 15 April 2011.
2. Manual operations involve excavating anomalies with hand tools.
3. The MFD-H for the primary MGFD is 87 feet. Instead of this distance, the K328 value for 1 lb NEW will be utilized.
4. This distance can be reduced by employing engineering controls authorized by Department of DDESB TP-16.
5. The K328 of the MEC treatment may not exceed the MFD-H of the MGFD. Operations will be limited to 2 lb MEC treatment for consolidated shots. For 2 lb, the K328 distance equals 413 feet which is less than the MFD-H of 521 feet. The K328 distance is calculated using the formula $D=328*W^{(1/3)}$.
6. MPPEH storage allows storage of up to 0.5 lb NEW.
7. Based on Table 7-9, Ordnance Publication (OP)-5, Volume 1, 7th Revision (NAVSEA, 2010). PTR is 60 percent of IBD.

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IWP\FIGURE_12_1_UXO-07_SITE_LOCATION.MXD MARTESE 6/15/2011 1:57:21 PM

Legend

- Surface Water
- Site UXO-07 Former Practice Hand Grenade Course (ASR # 2.77a and #2.77b) Boundary
- Installation Boundary

N

0 100 200 Feet

1 inch = 200 feet

Figure 12-1
UXO-07 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_12_2_DIGITAL_GEOPHYSICAL_MAPPING_RESULTS_UXO_07_PA_SI.MXD MARTESE 6/15/2011 2:05:58 PM

Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transect
- Site UXO-07 Boundary

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 12-2
Site UXO-07 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWPFIGURE_12_3_UXO-07_ESQD ARCS_PRIMARY_MCE.MXD

Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point PTR (142 ft)
- MPPEH Collection Point IBD (236 ft)
- Intentional Detonation EZ, All Personnel (328 ft)
- Unintentional Detonation EZ, TSD, Public, and Non-Essential Personnel (7 ft)
- Site UXO-07 Boundary

N

0 200 400 800 Feet

1 inch = 400 feet (1:4,800)

Figure 12-3
Site UXO-07
ESQD Arcs for the Primary MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL.

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\FIGURE_12_4_UXO-07_ESQD ARCS_CONTINGENCY_MGFD.MXD

Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point PTR (142 ft)
- MPPEH Collection Point IBD (236 ft)
- Intentional Detonation EZ, All Personnel (521 ft)
- Unintentional Detonation EZ, Public, and Non-Essential Personnel (62 ft)
- Site UXO-07 Boundary

N

0 200 400 800 Feet

1 inch = 400 feet (1:4,800)

Figure 12-4
Site UXO-07
ESQD Arcs for the Contingency MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

SECTION 13

UXO-11—Former B-5 Practice Hand Grenade Course (ASR #2.81)

13.1 Site Location and Description

Approximately 2 acres in size, Site UXO-11 is located north of Sixth Street and east of Foster Boulevard (**Figure 13-1**). The site is an undeveloped area covered with landscaped grass, which gently slopes southwest towards the traffic circle at the intersection of Sixth Street and Foster Boulevard. There is a small drainage swale on the southeast corner of the site and several other drainage swales surround the site. The drainage swale on the southeast corner of the site drains southwest towards the traffic circle. No historical structures or remnants of a practice hand grenade course are present. Current use of Site UXO-11 includes weekly athletic training exercises and occasional graduation ceremonies.

13.2 Site Geology and Hydrogeology

Inspection of the soil cores recovered to depths of up to 15 ft bgs from Site UXO-11 during the PA/SI indicated that the sediments are brown to gray poorly graded to well graded sand, with clayey sand layers occurring between 3 and 5 ft bgs in the center and southeastern portion of the site and an additional clayey sand layer between 8 and 10 ft bgs in the eastern portion of the site. These discontinuously layered sediments are generally consistent with those of the undifferentiated formation. (CH2M HILL, 2011b).

The water table of the surficial aquifer occurs in the undifferentiated formation at this site. Site-specific hydrogeologic information was derived from the five shallow temporary monitoring wells installed during the PA/SI for Site UXO-11. The temporary monitoring wells were screened in the surficial aquifer with screen bottom depths ranging from 12 to 15 feet bgs. Groundwater was found at depths of 0.21 to 1.82 feet bgs. Groundwater flows toward the center of the site from the southwest and northeast with a horizontal hydraulic gradient of 0.02 ft/ft in December 2009 (CH2M HILL, 2011b).

13.3 Site History and Previous Investigations

13.3.1 History

CH2M HILL completed an Archival Records Search Report for this site as part of the PA/SI (CH2M HILL, 2011b). Historical range overlay maps show Site UXO-11 first appearing as a practice hand grenade course in 1954 (USACE, 2001). This document also references a map from September 1, 1953 and states that while the range appeared on the 1954 range overlay map, Site UXO-11 was in use only during 1953. To date, no other historical reference to this area being used as a practice hand grenade course has been identified. Existing conditions maps from 1947 and 1953 include the area designated as Site UXO-11. These maps show a mockup structure (Building 507), presumably used for training exercises, within the site boundaries. This building is also seen on aerial photographs from 1946, 1948, and 1951.

Building 507 does not appear on maps after 1953. All aerial photographs from 1946, 1948, 1951, 1962, and 1989 show that the area designated as Site UXO-11 was clear of all vegetation except grass.

13.3.2 PA/SI

A PA/SI was conducted in 2009 for Site UXO-11 to evaluate the potential presence and nature of impacts to environmental media resulting from historical munitions use at the site, and to determine whether additional investigation and/or remediation activities were necessary. The May 2009 DGM survey covered approximately 11.5 percent (approximately 0.23 acre) of Site UXO-11. The DGM survey, which utilized a single-coil EM61-MK2 system, resulted in the selection of 70 anomalies representing potential subsurface MEC. **Figure 13-2** illustrates the DGM area and the distribution of anomalies identified as representing potential subsurface MEC.

Environmental sampling for MC analysis within Site UXO-11 consisted of:

- Twelve surface soil samples (0 to 2 inches bgs) collected from four DUs using the incremental sampling technique
- Five subsurface soil samples from soil cores collected using a DPT rig
- Two sediment and two surface water samples each were collected at co-located sites from the unnamed drainage swale in the southeastern portion of the site
- One groundwater sample was collected from each of the five temporary well locations

Samples were analyzed for explosives residues, including PETN and nitroglycerin (SW-846 USEPA Method 8330), perchlorate (USEPA Method 6850), and TAL metals (SW-846 USEPA Method 6010B and 7470/7471A). Surface water and groundwater samples were additionally analyzed for dissolved metals (USEPA SW-846 Method 6010B and 7470).

Explosives residues and metals were detected in site media and compared to applicable screening criteria, resulting in the following exceedances:

- **Surface soil** - nitroglycerin, arsenic, and chromium in (**Figure 13-3**).
- **Subsurface soil** - aluminum, arsenic chromium, and iron in (**Figure 13-4**).
- **Sediment** - Aluminum, arsenic, and chromium exceeded one or more comparison criteria in (**Figure 13-5**).
- **Groundwater** - nitrobenzene, arsenic, chromium, and cobalt (**Figure 13-6**).

The preliminary HHRS indicates that exposure to soil and surface water from Site UXO-11 would not result in any unacceptable risks to human health. The HHRS also indicates that potential contact with sediment and potable use of groundwater by current and future receptors could result in carcinogenic risks greater than the target level (primarily associated with chromium). Sediment and groundwater were both evaluated using screening values for hexavalent chromium, the more toxic (and carcinogenic) form of chromium for human receptors, and assuming residential type exposures to both media. The sediment evaluation was limited to two samples and the Step 3 screening (risk ratio using the 95% UCL of the mean as exposure concentrations) was not performed. Additionally, the use of hexavalent chromium toxicity information and residential soil screening values representative of more intensive exposures results in a significant overestimate of risks for potential exposure to sediment. Therefore, it was concluded that no unacceptable risks would be associated with exposure to the sediment by potential current and future receptors.

The HHRS determined that if the shallow groundwater for the area were used as a residential potable water supply, there could be unacceptable risks associated with the chromium detected in groundwater. However, this is primarily associated with the assumption that all of the chromium detected in the groundwater is in the hexavalent form, which is unlikely, as discussed previously. It should also be noted that the shallow groundwater is not currently used as a potable water supply at Site UXO-11 or MCB CamLej, and it is unlikely that it would be in the future. The more likely exposure scenario, exposure to the shallow groundwater by construction workers during excavation activities, is unlikely to result in any unacceptable risks. Because the exposure to groundwater for a construction worker is much lower than that for residential potable use, the risk to the construction worker would be within acceptable risk levels.

Although five detected metals (aluminum, cadmium, iron, lead, and vanadium) had concentrations in excess of ESVs in surface soil, three metals in subsurface soil (aluminum, iron, and vanadium), two metals (lead and zinc) in sediment, one metal (cadmium) in surface water, and four total metals (aluminum, beryllium, cadmium, and iron) and two dissolved metals (aluminum and beryllium) in groundwater had concentrations in excess of the ESVs. All of these analytes had HQs below or just slightly above 1.0, therefore none of these analytes is expected to pose an unacceptable risk to ecological receptors.

Although no unacceptable human health or ecological risks were identified from exposure to site media, additional environmental characterization sampling is necessary for explosives residues and hexavalent chromium due to the frequency of detection in soil, sediment, and groundwater.

Based on the DGM results, the report recommended that an intrusive investigation be performed to assess the nature of the identified geophysical anomalies.

13.4 Field Activities

13.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

13.4.2 Environmental Sampling and Analysis

Sampling activities will be conducted within Site UXO-11 as follows:

Surface Soil Sampling

Surface soil samples will be collected from 20 locations at depths of 0 to 2 inches bgs within each of the DUs established during the PA/SI, (**Figure 13-7)**. If MEC is identified at the site, one or more of the samples will be collected as a pre-detonation sample and analyzed for the same parameters.

Surface soil samples will be analyzed for explosives residues (by EPA Method SW-846 8330), perchlorate (by EPA Method SW-846 6850), chromium (by USEPA Method SW-846 6010B) and hexavalent chromium (by EPA Method SW846 7196) at a fixed-base laboratory (**Table 13-1**).

Subsurface Soil Sampling

A total of 20 subsurface soil samples (collocated with the surface soil samples) will be collected from hand augered soil borings. The samples will be collected from unsaturated soil immediately above the water table (estimated at 5 feet bgs) (**Figure 13-7**). Subsurface soil samples will be analyzed for explosives residues (by EPA Method SW-846 8330), perchlorate (by EPA Method SW-846 6850), chromium (by USEPA Method SW-846 6010B) and hexavalent chromium (by EPA Method SW846 7196) at a fixed-base laboratory (**Table 13-1**).

Surface Water Sampling

Two surface water samples will be collected from the unnamed drainage swale in the southeastern portion of the site (**Figure 13-9**). Samples will be collected first from the downstream location and then the upstream location. If no surface water is present at the planned locations, the samples will be collected from the nearest available surface water within the drainage swale.

Surface water samples will be analyzed for explosives residues (including nitroglycerin and PETN, by EPA Method SW-846 8330), perchlorate (by EPA Method SW-846 6850), total chromium (by USEPA Method SW-846 6010B) and hexavalent chromium (by EPA Method SW846 7196) at a fixed-base laboratory (**Table 13-1**).

Sediment Sampling

Two sediment samples will be collected from the unnamed drainage swale in the southeastern portion of the site at the same locations as the surface water samples (**Figure 3-8**).

TABLE 13-1
Summary of Sampling Program at UXO-11

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis: PETN and Nitro-glycerin	Analysis: Nitroaromatics and Nitromines	Analysis: Perchlorate	Analysis: Total Chromium	Analysis: Hexavalent Chromium
Surface Soil	MR11-SS01-11B through MR11-SS20-11B	Grab surface soil samples will be collected using a clean trowel from 0 to 2 inches bgs and placed into the sample container Will allow for confirmation of the concentrations of explosives residue, perchlorate, chromium, and hexavalent in surface soil	20	20	20	20	20
Subsurface Soil	MR11-SB06-11B through MR11-SB25-11B	Grab subsurface soil samples will be collected using a clean trowel from 0 to 2 inches bgs and placed into the sample container Will allow for confirmation of the concentrations of explosives residue, perchlorate, chromium, and hexavalent in subsurface soil	20	20	20	20	20
Surface Water	MR11-SW03-11B through MR11-SW04-11B	Grab surface water samples will be collected directly into the sample containers. Will allow for confirmation of the concentration of explosives residue, perchlorate, total chromium (total and dissolved), and hexavalent chromium (total and dissolved) in surface water upstream and downstream of the PA/SI sample locations	2	2	2	2	2

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis				
			PETN and Nitro-glycerin	Nitroaromatics and Nitromines	Perchlorate	Total Chromium	Hexavalent Chromium
Sediment	MR11-SD03-11B through MR11-SD04-11B	Grab sediment samples will be collected using a clean trowel, drained of water, and placed into the sample container. Will allow for confirmation of the concentration of explosives residue, perchlorate, chromium, and hexavalent in sediment upstream and downstream of the PA/SI sample locations	2	2	2	2	2
Unfiltered Groundwater	MR11-GW01-11B through MR11-GW05-11B	Low-flow purge methodology will be used to collect groundwater samples. Will allow for the confirmation of explosives residue, perchlorate, chromium, and hexavalent chromium concentrations in low turbidity groundwater samples	5	5	5	5	5
Filtered Groundwater	MR11-GW01-11B through MR11-GW05-11B	Low-flow purge methodology will be used to collect groundwater samples and the samples will be filtered in the field. Will allow for the measurement of dissolved chromium and hexavalent chromium concentrations in groundwater	0	0	0	5	5

At each location, the surface water samples will be collected before the sediment samples. Sediment will be collected by advancing a clean trowel approximately 6–12 inches into the sediment, drained of excess water, and placed into the appropriate sample containers.

Sediment samples will be analyzed for explosives residues (including nitroglycerin and PETN, by EPA Method SW-846 8330), perchlorate (by EPA Method SW-846 6850), total chromium (by USEPA Method SW-846 6010B) and hexavalent chromium (by EPA Method SW846 7196) at a fixed-base laboratory (**Table 13-1**).

Well Installation and Groundwater Sampling

Permanent monitoring wells will be installed in five locations (**Figure 13-8)** via hollow stem auger. Each well will be constructed in accordance with the specifications previously described in **Section 11.4.2**. Groundwater sampling will also be performed as described in **Section 11.4.2**.

Groundwater samples will be analyzed for explosives residues (including nitroglycerin and PETN, by EPA Method SW-846 8330), perchlorate (by EPA Method SW-846 6850), total chromium and dissolved chromium (by USEPA Method SW-846 6010B) and hexavalent chromium (by EPA Method SW846 7196) at a fixed-base laboratory (**Table 13-1**).

13.4.3 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the UFP-SAP (**Appendix B**).

13.4.4 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-11 includes reacquisition and investigation of the 86 anomalies that were identified as representing potential subsurface MEC/MPPEH at the site during the PA/SI (**Figure 13-2**). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission

The intrusive investigation at Site UXO-11 will be conducted in accordance with the Base-wide ESS (CH2M HILL, 2011d). Intrusive investigation activities will not be conducted until approval of the ESS is received from MARCORSYSCOM.

Operations in Populated and Sensitive Areas

Site UXO-11 is not located in a populated area. No jurisdictional wetlands or habitat for threatened or endangered species are located within the site.

Exclusion Zones and Separation Distances

The primary MDFD for the site is the Hand grenade M204 Fuze. The contingency MGFD is the Mk II grenade. Exclusion zone parameters are provided on **Table 13-2** and are shown on **Figures 13-9** (for the primary MGDF) and **13-11** (for the contingency MGFD).

TABLE 13-2
Exclusion Zone Parameters for Site UXO-07

Operation	Sited as	ES	Basis	ESQD[1] (feet)
Primary MGFD (Hand Grenade M204 Fuze)				
Manual operations[2]	Unintentional detonation	UXO teams	K40 of the MGFD	6
Manual operations[2]	Unintentional detonation	Public and non-essential personnel	HFD of the MGFD	7
MEC treatment up to 1 lb NEW	Intentional detonation	Public and all personnel	K328 of 1 lb NEW[3]	328[3,4]
Contingency MGFD (Mk II Grenade)				
Manual operations[2]	Unintentional detonation	UXO teams	K40 of the MGFD	33
Manual operations[2]	Unintentional detonation	Public and non-essential personnel	HFD of the MGFD	62
MEC treatment up to 1 lb NEW[5]	Intentional detonation	Public and all personnel	MFD of the MGFD	521[4]
MPPEH Collection				
MPPEH collection area for onsite consolidation, storage, and re-inspection (up to 1 lb NEW)[6]	Metal Storage Container (e.g., 55-gallon drum or CONEX box)	Non-essential personnel in structures	Inhabited Building Distance (IBD)[7]	291
		Non-essential personnel in the open	Public Transportation Route (PTR)[7]	175

Table notes:
1. From Fragmentation Data Review Form, Updated 15 April 2011.
2. Manual operations involve excavating anomalies with hand tools.
3. The MFD-H for the primary MGFD is 87 ft. Instead of this distance, the K328 value for 1 lb NEW will be utilized.
4. This distance can be reduced by employing engineering controls authorized by DDESB TP-16.
5. The K328 of the MEC treatment may not exceed the MFD-H of the MGFD. Operations will be limited to 2 lb MEC treatment for consolidated shots. For 2 lb, the K328 distance equals 413 feet which is less than the MFD-H of 521 feet. The K328 distance is calculated using the formula $D=328*W^{(1/3)}$.
6. MPPEH storage allows storage of up to 1 lb NEW.
7. Based on Table 7-9, Ordnance Publication (OP)-5, Volume 1, 7th Revision (NAVSEA, 2010). PTR is 60 percent of IBD.

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_13_1_UXO-11_SITE_LOCATION.MXD MARTESE 6/7/2011 1:53:42 PM

Legend

Site UXO-11 - Former B-5 Hand Grenade Course (ASR #2.81) boundary

Installation Boundary

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 13-1
UXO-11 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_13_2_DIGITAL_GEOPHYSICAL_MAPPING_RESULTS_UXO_11_PA_SI.MXD MARTESE 6/27/2011 9:08:09 AM

Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transects
- Site UXO-11 Boundary

N

0 40 80 160 Feet

1 inch = 80 feet

Figure 13-2
Site UXO-11 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
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North Carolina

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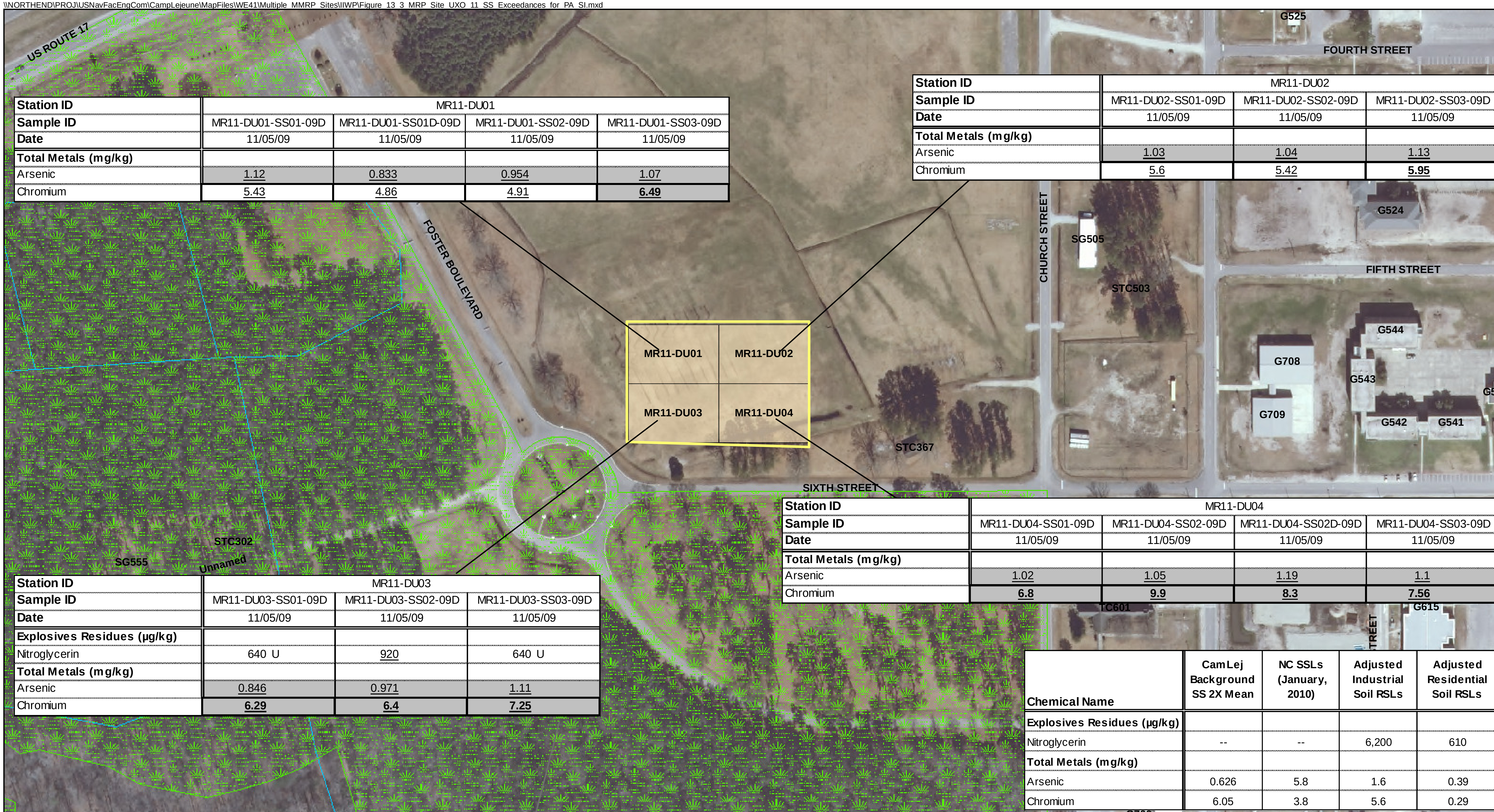

Station ID	MR11-DU01			
Sample ID	MR11-DU01-SS01-09D	MR11-DU01-SS01D-09D	MR11-DU01-SS02-09D	MR11-DU01-SS03-09D
Date	11/05/09	11/05/09	11/05/09	11/05/09
Total Metals (mg/kg)				
Arsenic	1.12	0.833	0.954	1.07
Chromium	5.43	4.86	4.91	**6.49**

Station ID	MR11-DU02		
Sample ID	MR11-DU02-SS01-09D	MR11-DU02-SS02-09D	MR11-DU02-SS03-09D
Date	11/05/09	11/05/09	11/05/09
Total Metals (mg/kg)			
Arsenic	1.03	1.04	1.13
Chromium	5.6	5.42	**5.95**

Station ID	MR11-DU04			
Sample ID	MR11-DU04-SS01-09D	MR11-DU04-SS02-09D	MR11-DU04-SS02D-09D	MR11-DU04-SS03-09D
Date	11/05/09	11/05/09	11/05/09	11/05/09
Total Metals (mg/kg)				
Arsenic	1.02	1.05	1.19	1.1
Chromium	**6.8**	**9.9**	**8.3**	**7.56**

Station ID	MR11-DU03		
Sample ID	MR11-DU03-SS01-09D	MR11-DU03-SS02-09D	MR11-DU03-SS03-09D
Date	11/05/09	11/05/09	11/05/09
Explosives Residues (µg/kg)			
Nitroglycerin	640 U	920	640 U
Total Metals (mg/kg)			
Arsenic	0.846	0.971	1.11
Chromium	**6.29**	**6.4**	**7.25**

Chemical Name	CamLej Background SS 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Explosives Residues (µg/kg)				
Nitroglycerin	--	--	6,200	610
Total Metals (mg/kg)				
Arsenic	0.626	5.8	1.6	0.39
Chromium	6.05	3.8	5.6	0.29

Legend
- Surface Water
- Jurisdictional Wetland Area
- Decision Unit (120 ft x190 ft)
- Site UXO-11 Boundary

Notes:
Analytical exceedances from the PA/SI
Shading indicates exceedance of two times the mean base background concentration for surface soil
Bold box indicates exceedance of NC SSL
Bold text indicates exceedance of Adjusted Industrial Soil RSL
Underline indicates exceedance of Adjusted Residential Soil RSL
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
U - The material was analyzed for, but not detected
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 13-3
Site UXO-11 Surface Soil Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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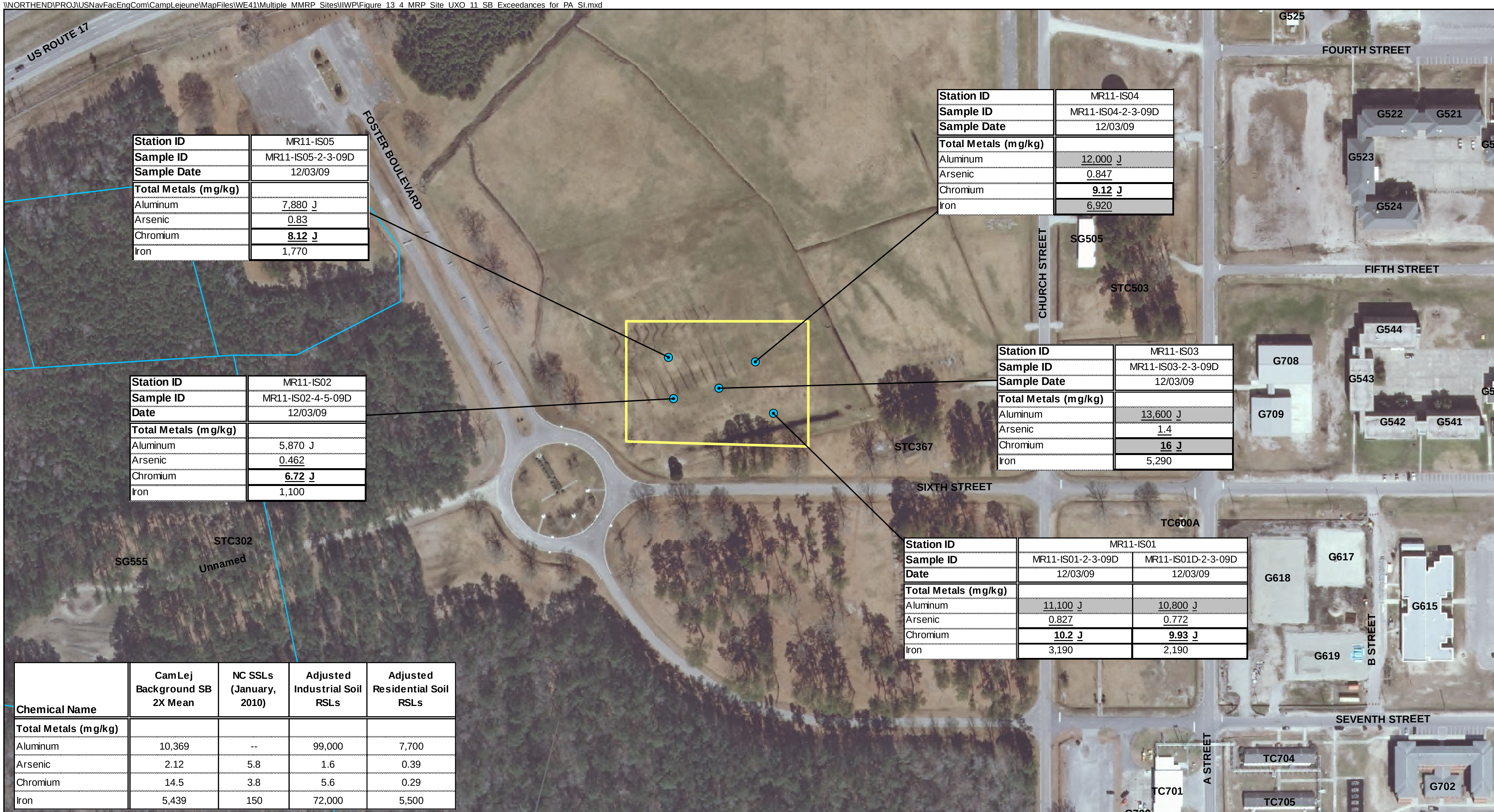

Station ID	MR11-IS05
Sample ID	MR11-IS05-2-3-09D
Sample Date	12/03/09
Total Metals (mg/kg)	
Aluminum	<u>7,880 J</u>
Arsenic	<u>0.83</u>
Chromium	**<u>8.12 J</u>**
Iron	1,770

Station ID	MR11-IS04
Sample ID	MR11-IS04-2-3-09D
Sample Date	12/03/09
Total Metals (mg/kg)	
Aluminum	<u>12,000 J</u>
Arsenic	<u>0.847</u>
Chromium	**<u>9.12 J</u>**
Iron	<u>6,920</u>

Station ID	MR11-IS02
Sample ID	MR11-IS02-4-5-09D
Date	12/03/09
Total Metals (mg/kg)	
Aluminum	5,870 J
Arsenic	<u>0.462</u>
Chromium	**<u>6.72 J</u>**
Iron	1,100

Station ID	MR11-IS03
Sample ID	MR11-IS03-2-3-09D
Sample Date	12/03/09
Total Metals (mg/kg)	
Aluminum	<u>13,600 J</u>
Arsenic	<u>1.4</u>
Chromium	**<u>16 J</u>**
Iron	5,290

Station ID	MR11-IS01	
Sample ID	MR11-IS01-2-3-09D	MR11-IS01D-2-3-09D
Date	12/03/09	12/03/09
Total Metals (mg/kg)		
Aluminum	<u>11,100 J</u>	<u>10,800 J</u>
Arsenic	<u>0.827</u>	<u>0.772</u>
Chromium	**<u>10.2 J</u>**	**<u>9.93 J</u>**
Iron	3,190	2,190

Chemical Name	CamLej Background SB 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Total Metals (mg/kg)				
Aluminum	10,369	--	99,000	7,700
Arsenic	2.12	5.8	1.6	0.39
Chromium	14.5	3.8	5.6	0.29
Iron	5,439	150	72,000	5,500

Legend

- Subsurface Soil Sampling Locations
- Surface Water
- Site UXO-11 Boundary

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

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 13-4
Site UXO-11 Subsurface Soil Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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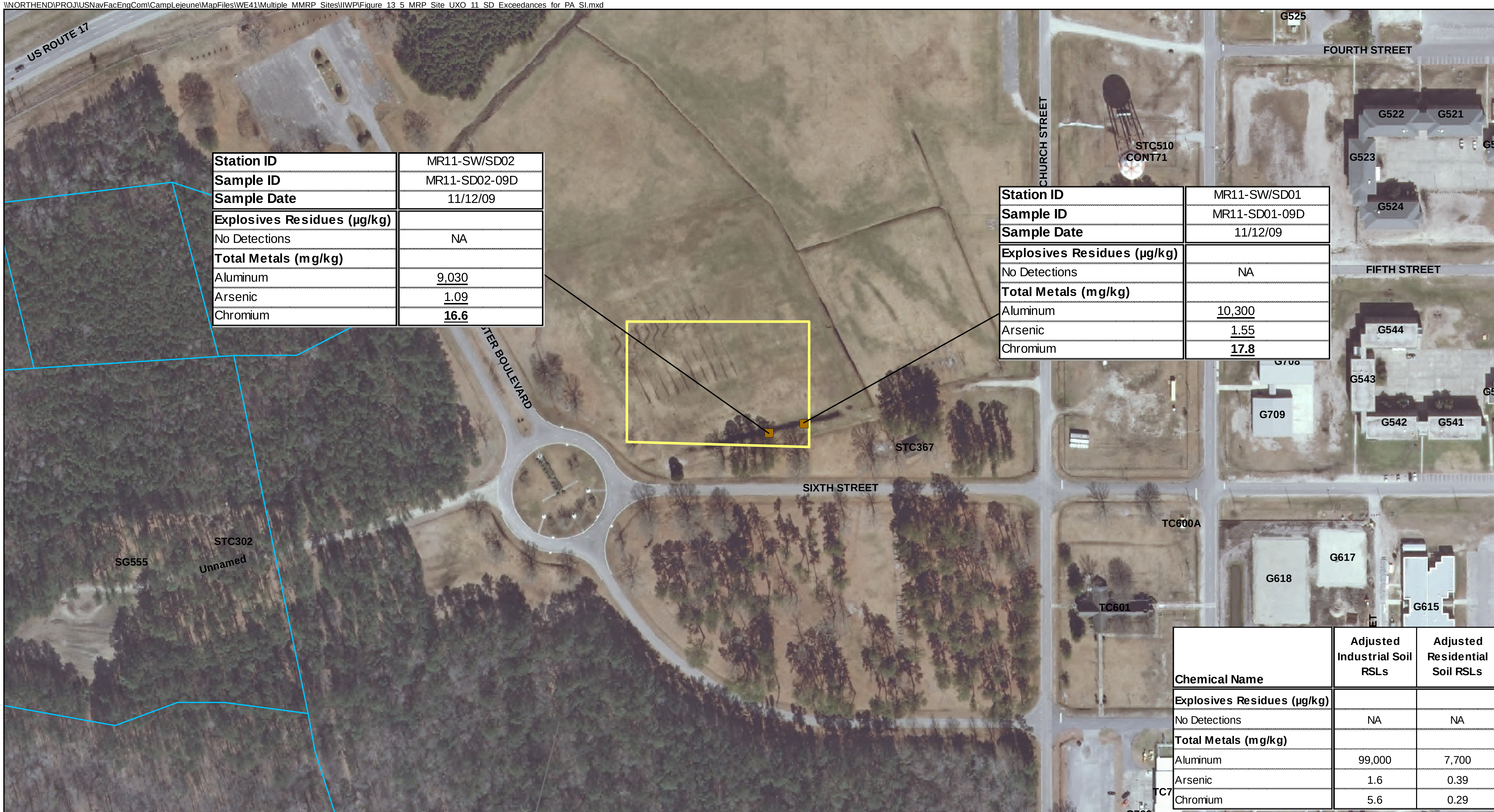

Station ID	MR11-SW/SD02
Sample ID	MR11-SD02-09D
Sample Date	11/12/09
Explosives Residues (µg/kg)	
No Detections	NA
Total Metals (mg/kg)	
Aluminum	9,030
Arsenic	1.09
Chromium	**16.6**

Station ID	MR11-SW/SD01
Sample ID	MR11-SD01-09D
Sample Date	11/12/09
Explosives Residues (µg/kg)	
No Detections	NA
Total Metals (mg/kg)	
Aluminum	10,300
Arsenic	1.55
Chromium	**17.8**

Chemical Name	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Explosives Residues (µg/kg)		
No Detections	NA	NA
Total Metals (mg/kg)		
Aluminum	99,000	7,700
Arsenic	1.6	0.39
Chromium	5.6	0.29

Legend

- Sediment Sampling Location
- Surface Water
- Site UXO-11 Boundary

Notes:
Analytical exceedances from the PA/SI
Bold text indicates exceedance of Adjusted Industrial Soil RSLs
Underline indicates exceedance of Adjusted Residential Soil RSLs
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
NA - Not applicable
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram

N

0 100 200 400
Feet

1 inch = 200 feet

Figure 13-5
Site UXO-11 Sediment Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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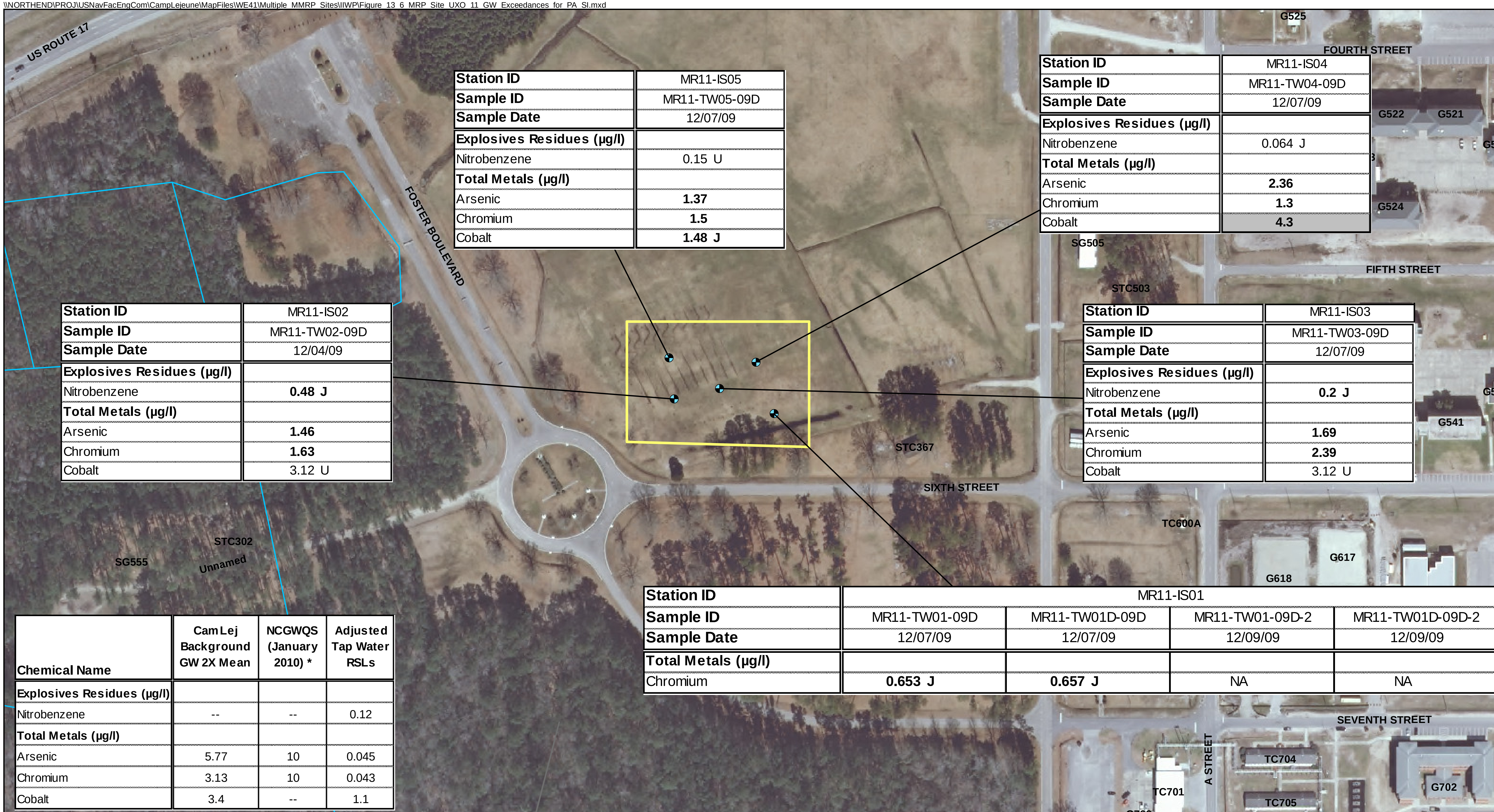

Station ID	MR11-IS05
Sample ID	MR11-TW05-09D
Sample Date	12/07/09
Explosives Residues (µg/l)	
Nitrobenzene	0.15 U
Total Metals (µg/l)	
Arsenic	**1.37**
Chromium	**1.5**
Cobalt	**1.48 J**

Station ID	MR11-IS04
Sample ID	MR11-TW04-09D
Sample Date	12/07/09
Explosives Residues (µg/l)	
Nitrobenzene	0.064 J
Total Metals (µg/l)	
Arsenic	**2.36**
Chromium	**1.3**
Cobalt	**4.3**

Station ID	MR11-IS02
Sample ID	MR11-TW02-09D
Sample Date	12/04/09
Explosives Residues (µg/l)	
Nitrobenzene	**0.48 J**
Total Metals (µg/l)	
Arsenic	**1.46**
Chromium	**1.63**
Cobalt	3.12 U

Station ID	MR11-IS03
Sample ID	MR11-TW03-09D
Sample Date	12/07/09
Explosives Residues (µg/l)	
Nitrobenzene	**0.2 J**
Total Metals (µg/l)	
Arsenic	**1.69**
Chromium	**2.39**
Cobalt	3.12 U

Station ID	MR11-IS01			
Sample ID	MR11-TW01-09D	MR11-TW01D-09D	MR11-TW01-09D-2	MR11-TW01D-09D-2
Sample Date	12/07/09	12/07/09	12/09/09	12/09/09
Total Metals (µg/l)				
Chromium	**0.653 J**	**0.657 J**	NA	NA

Chemical Name	CamLej Background GW 2X Mean	NCGWQS (January 2010) *	Adjusted Tap Water RSLs
Explosives Residues (µg/l)			
Nitrobenzene	--	--	0.12
Total Metals (µg/l)			
Arsenic	5.77	10	0.045
Chromium	3.13	10	0.043
Cobalt	3.4	--	1.1

Legend

- Groundwater Sample Locations
- Surface Water
- Site UXO-11 Boundary

Notes:
Analytical exceedances from the PA/SI
Shading indicates exceedance of two times the mean base background concentration for Groundwater
Bold box indicates exceedance of NCGWQS or the more conservative MCL
Bold text indicates exceedance of Adjusted Tap Water RSLs
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
* - The MCL-Groundwater value is reported in place of the NCGWQS where the MCL value is more conservative.
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
µg/kg - Micrograms per kilogram

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 13-6
Site UXO-11 Groundwater Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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Legend
- Proposed Surface and Subsurface Soil Sampling Location
- Site UXO-11 Boundary
- Sampling Decision Unit (120 ft x190 ft)
- Jurisdictional Wetland Area

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 13-7
Site UXO-11 Surface and Subsurface Soil Sampling Locations
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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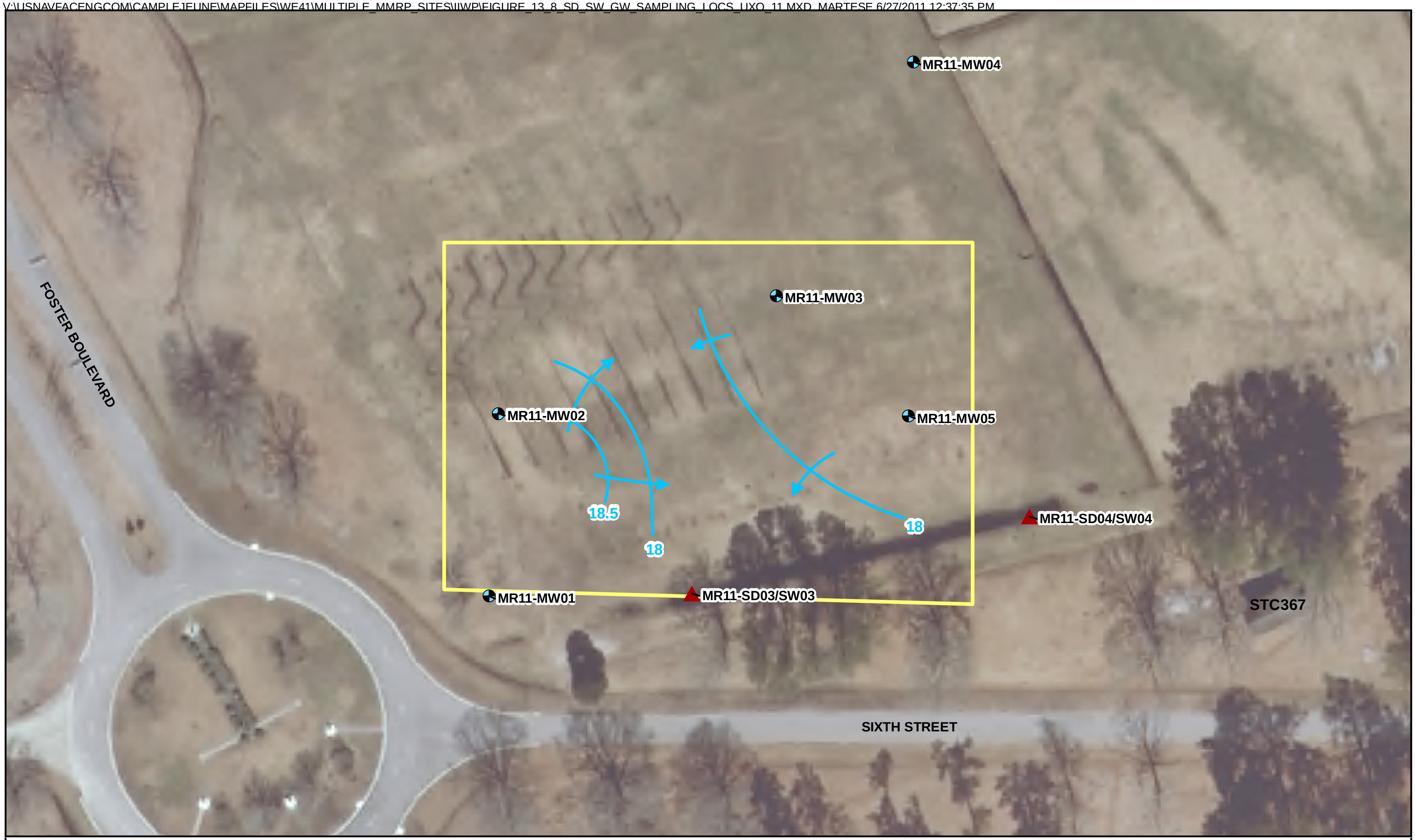

Legend

- Proposed Monitoring Well
- Proposed Sediment/Surface Water Sampling Location
- Potentiometric Contour
- Groundwater Flow Direction
- Site UXO-11 Boundary

Note: Potentiometric surface contours have been inferred between temporary well locations. Actual conditions may differ from those shown here.
17.74 - groundwater elevation in feet above mean sea level
Water levels gauged December 2009

N

0 50 100 Feet

1 inch = 100 feet

Figure 13-8
Sediment, Surface Water, and Groundwater Sampling Locations at UXO-11
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\FIGURE_13_9_UXO-11_ESQD ARCS_PRIMARY_MGFD.MXD

Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point IBD (291 ft)
- MPPEH Collection Point PTR (175 ft)
- Intentional Detonation EZ, All Personnel (328 ft)
- Unintentional Detonation EZ, TSD, Public, and Non-Essential Personnel (7 ft)
- Site UXO-11 Boundary

N

0 100 200 400 Feet

1 inch = 200 feet (1:2,400)

Figure 13-9
Site UXO-11
ESQD Arcs for the Primary MFGD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL.

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\FIGURE_13_10_UXO-11_ESQD ARCS_CONTINGENCY_MGFD.MXD

Legend

- Entry Control Point
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point IBD (291 ft)
- MPPEH Collection Point PTR (175 ft)
- Intentional Detonation EZ, All Personnel (521 ft)
- Intentional Detonation EZ, Public, and Non-Essential Personnel (62 ft)
- Site UXO-11 Boundary

N

0 125 250 500 Feet

1 inch = 250 feet (1:3,000)

Figure 13-10
Site UXO-11
ESQD Arcs for the Contingency MFGD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL.

SECTION 14

UXO-14—Former Indoor Pistol Range (ASR #2.199) and Gas Chamber (ASR #2.200)

14.1 Site Location and Description

Site UXO-14 includes two separate areas located west of Powder Lane in the Stones Bay area of MCB CamLej (**Figure 14-1**). The eastern area of Site UXO-14, the Former Indoor Pistol Range area, includes approximately 0.09 acres of level terrain consisting of maintained grass and a loose sandy area in the vicinity of the former building footprint. Construction debris, unrelated to the site, was stockpiled but removed from the Former Indoor Pistol Range area prior to the 2009 PA/SI field activities.

The western area of Site UXO-14, the Former Gas Chamber area, is approximately 0.04 acres in size and is heavily wooded with thick underbrush. The land surface within the Former Gas Chamber area slopes toward the south and west, toward an unnamed tributary of the New River. The Former Gas Chamber area been used for scrap metal storage, though none was present during the 2009 PA/SI field activities. No surface water bodies were observed within Site UXO-14.

14.2 Site Geology and Hydrogeology

Soil cores from borings with depths ranging from 10 to 15 feet bgs were inspected as part of the PA/SI for Site UXO-14 and provided information regarding site-specific geology. Shallow deposits at the site consist of discontinuous layers of fine-grained sediments consistent with the undifferentiated formation. Soil boring logs indicate sediments ranging from clay to fine-grained sand. (CH2M HILL, 2011c).

The water table of the surficial aquifer occurs in the undifferentiated formation at this site. Site-specific hydrogeologic information was derived from the installation of four temporary monitoring wells during the PA/SI. The temporary wells were screened in the surficial aquifer at with screen bottom depths ranging from 15 to 18 feet bgs. In December 2009, groundwater flow in the surficial aquifer generally flowed toward the southwest with a horizontal hydraulic gradient of approximately 0.02 ft/ft in the vicinity of the former pistol range was (CH2M HILL, 2011c).

14.3 Site History and Previous Investigations

14.3.1 History

CH2M HILL completed an Archival Records Search Report for this site as part of the PA/SI (CH2M HILL, 2011c). The Indoor Pistol Range first appears on existing conditions maps in 1950 as Building RR-53 According to the *Final Range Identification and Preliminary Range Assessment*, the pistol range was present on base maps until 1996 (USACE, 2001). The Indoor Pistol Range appears in the 1962 and 1989 historical aerial photographs. According to Base

Range Safety Officer, Duane Richardson, the Indoor Pistol Range was only used for small arms training.

The Gas Chamber first appeared on the 1950 existing conditions maps as Building RR-63; it was labeled as a Gas Chamber until 1954. After 1954, Building RR-63 was used for storage and was present on maps until 1965. However, on the 1962 historical aerial photograph, the area is completely overgrown and Building RR-63 is not visible. The 1989 historical aerial photograph also shows the area as being heavily wooded. According to the *Final Range Identification and Preliminary Range Assessment,* it is assumed that tear gas was used at this facility (USACE, 2001).

14.3.2 PA/SI

A PA/SI was conducted in 2009 for Site UXO-14 to evaluate the potential presence and nature of impacts to environmental media resulting from historical munitions use at the site, and to determine whether additional investigation and/or remediation activities were necessary. The DGM survey conducted in May 2009 covered approximately 20 percent (approximately 0.008 acres) of the Former Gas Chamber portion of Site UXO-14. The DGM survey, which utilized using a single-coil EM61-MK2 system, yielded a total of 17 geophysical anomalies representing potential subsurface MEC, primarily concentrated in the eastern half of the site (CH2M HILL, 2011c). **Figure 14-2** shows the DGM area and the distribution of anomalies representing potential subsurface MEC.

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

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

Soil samples collected from the Former Indoor Pistol Range area of Site UXO-14 were analyzed for TAL metals (SW-846 USEPA Method 6010B and 7471A). Soil samples collected from the Former Gas Chamber area of Site UXO-14 were analyzed for SVOCs (SW 846 USEPA Method 8270C). Groundwater samples were analyzed for total and dissolved metals (SW-846 USEPA Method 6010B and 7470) (within the Former Indoor Pistol Range area of Site UXO-14 only) and SVOCs (SW 846 USEPA Method 8270C) (within the Former Gas Chamber area of Site UXO-14 only).

Human health and ecological risk screening indicates that further investigation of Site UXO-14 is necessary to assess the extent of metals concentrations greater than screening values within the surface and subsurface soils at the Former Indoor Pistol Range area. Surface and subsurface soil exceedances of screening criteria are shown on **Figure 14-3** and **Figure 14-4,** respectively. Antimony, mercury (from Ecological Risk Screening [ERS] only), and lead were identified as COPCs in surface soils within the Former Indoor Pistol Range area during the ERS and HHRS processes. Antimony and lead were identified as COPCs in subsurface soils within the Former Indoor Pistol Range area. The risk screening process indicated that the detected concentrations of SVOCs and metals in Site UXO-14 groundwater did not present an unacceptable risk to human health or ecological receptors. Because no unacceptable human health or ecological risks were identified from exposure to soil and groundwater within the Former Gas Chamber area of Site UXO-14, no further environmental characterization sampling was recommended within the Former Gas Chamber area.

Based on the DGM results, the report recommended that an intrusive investigation be performed to assess the nature of the geophysical anomalies representing potential subsurface MEC at the Former Gas Chamber area. The need for additional sampling of MC related to anomaly investigation will be re-evaluated. Additional investigation should be conducted to assess the extent of the identified impacts to surface and subsurface soil at the Former Indoor Pistol Range area.

14.4 Field Activities

14.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

14.4.2 Environmental Sampling and Analysis

Sampling activities will be conducted within Site UXO-14 as follows:

Surface Soil Sampling

Fourteen samples will be collected using the TR-02-1 sampling method. Each sampling location will be defined as an area 1m × 1m, shown on **Figure 14-5**. The same procedures for Site UXO-02 surface soil sampling will be followed, with samples collected from depths of 0 to 2 inches.

Surface soil samples will be analyzed for antimony, lead, and mercury (by USEPA Method SW-846 6010C and 7471B) at a fixed-base laboratory (**Table 14-1**).

Subsurface Soil Sampling

Seven subsurface soil samples will be collected from unsaturated soil immediately above the water table (estimated at 5 feet bgs) by hand augering. Two subsurface samples will be located within the Site UXO-14 boundary and another 5 samples will be collected outside the Site UXO-14 boundary at locations shown on **Figure 14-5.**). The sample locations will be selected in a manner similar to that described earlier for UXO-02 surface soil sampling. Subsurface soil samples will be analyzed for antimony, lead, and mercury (by USEPA Method SW-846 6010C and 7471B) at a fixed-base laboratory (**Table 14-1**).

TABLE 14-1
Summary of Soil Sampling and Analysis Program at UXO-14

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis: Select Metals (Antimony, Lead, Mercury)
Surface Soil	MR14-SS21-11B through MR14-SS32-11B	TR-02-01 methodology will be used to collect soil from 0 – 2 inches bgs. Will allow for determination of the concentration and horizontal extent of antimony, lead, and mercury contamination in surface soil	14
Subsurface Soil	MR14-SB22-11B through MR14-SB28-11B	Hand auger will be used to collect discrete samples just above the water table, approximately 5 feet bgs. Will allow for determination of the concentration and vertical extent of antimony, lead, and mercury contamination in subsurface soil	7

14.4.3 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the UFP-SAP (**Appendix B**).

14.4.4 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-14 includes reacquisition and investigation of 17 anomalies at the Former Gas Chamber portion of Site UXO-14 that were identified as during the PA/SI as representing potential subsurface MEC (**Figure 14-2**). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission

At Site UXO-14, an ESS determination request will need to be submitted for intrusive activities. Previously, a MARCORSYSCOM determination was received for the PA/SI activities, during which anomaly avoidance was practiced (MARCORSYSCOM, 2009). Intrusive investigation activities will not be conducted until the ESS determination is received from MARCORSYSCOM.

Operations in Populated and Sensitive Areas

Site UXO-14 is not located in a populated area. No jurisdictional wetlands or habitat for threatened or endangered species are located within the site.

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Legend

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

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 14-1
UXO-14 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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Legend

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

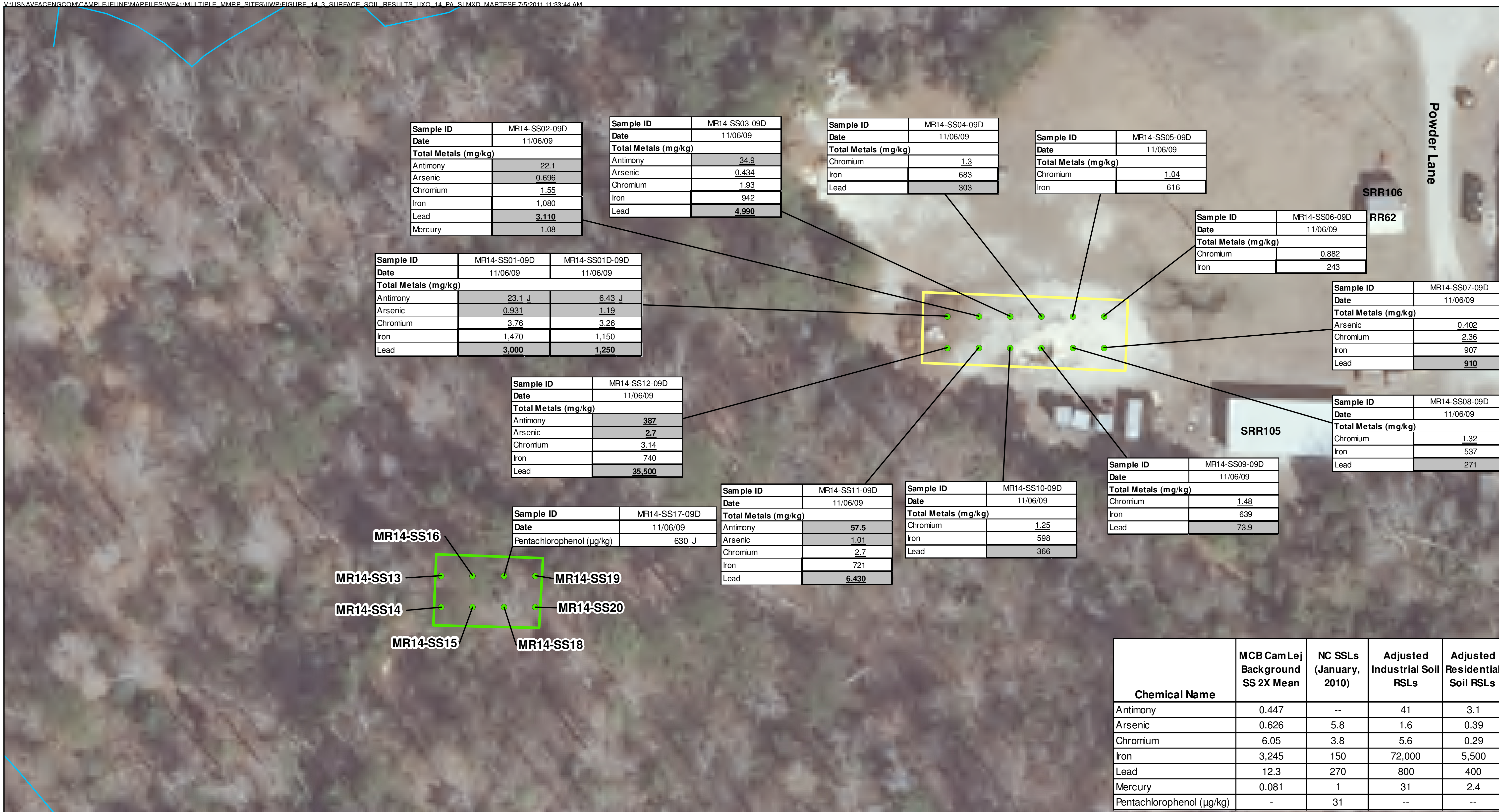
N

0 10 20 40 Feet

1 inch = 20 feet

Figure 14-2
Site UXO-14 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL



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

Legend

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

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

N

0 25 50 100 Feet

1 inch = 50 feet

Figure 14-3
Site UXO-14 Surface Soil Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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

Legend

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

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

N

0 25 50 100 Feet

1 inch = 50 feet

Figure 14-4
Site UXO-14 Subsurface Soil Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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Legend

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

N

0 12.5 25 50 Feet

1 inch = 25 feet

Figure 14-5
UXO-14 Surface/Subsurface Soil Sampling Locations
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

SECTION 15

UXO-17—Former Firing Position 2 (ASR #2.12)

15.1 Site Location and Description

Site UXO-17 is approximately 16 acres in area and is located east of the intersection of Piney Green Road and Old Bear Creek Road (**Figure 15-1**). The site is accessible from Old Bear Creek Road, which crosses the southern portion of the investigation area. In addition, a fence associated with the Base landfill is located in the southeast portion of Site UXO-17.

The site is located approximately 23 feet above msl. The site topography gently slopes to the southeast, with little relief besides manmade earthen mounds and "foxholes". Construction debris is found in piles and pits onsite. Surface water runoff at Site UXO-17 flows into localized drainage ditches which in turn drain to Wallace Creek. Surface water also ponds in the south-central portion of the site. Prior to investigation activities, approximately 60 percent of the site was wooded with the remainder of the site cleared of vegetation.

15.2 Site Geology and Hydrogeology

Soil and groundwater sampling activities conducted during the PA/SI provided site-specific information relating to site geology and shallow groundwater. The shallow soils predominantly consisted of brown, tan, grey, and white fine-grained sands to fine-grained silty sands. Discontinuous layers of grey, sandy clay was noted at depths of 3 to 3.75 feet below ground surface (bgs) on the west portion of the site, and white clay and clayey silt at 2.5 to 5 feet bgs deepening to 10 feet bgs was observed in the east portion of the site. Deeper soils were generally silty clay and clayey silt and poorly graded sands, extending to the maximum depth of the investigation, 16 feet bgs. The water table was encountered at depths ranging from 3 to 11 feet bgs.

Shallow groundwater flow is toward the north-northwest with a hydraulic gradient of approximately 0.02 ft/ft.

15.3 Site History and Previous Investigations

History

Site UXO-17 (ASR#2.212) was reportedly used as a firing position from the 1950s through at least 1985. The current MCB CamLej Range Safety Officer stated that 105-mm and 155-mm howitzers were used at this site to fire practice rounds into the K-2 and G-10 Impact Areas (CH2M HILL, 2010c). In addition, the MCB CamLej Range Control Officer stated that 4.2-inch mortars, 175-mm guns, 8-inch howitzers, and 120-mm mortars also may have been used, with unused projectile propellant being burnt on the ground. No CWM was reported to have been used at this site. Based on concrete, metal drums, and other scrap metal encountered during intrusive investigation of a portion of the site, it is likely that portions of the site were also used for disposal of construction debris.

2008 Focused PA/SI

A focused PA/SI was conducted in September and October 2008 over the central 4-acres of Site UXO-17 that included DGM and environmental sampling. DGM was conducted over the entire 4-acre portion of the site using an EM61-MK2A, with the exception of areas that could not be accessed due to irregular terrain, dense trees, or construction debris (concertina wire). A total of 1,310 anomalies and 21 saturated response areas were identified from the DGM data as representing potential subsurface MEC in the 4-acre portion of the site (as shown on **Figure 15-2**). A saturated response area is where a subsurface anomaly or multiple subsurface anomalies are present for which the signal is so strong that one cannot distinguish between individual anomalies.

The highest concentration of anomalies was located across the central portion of the 4-acre portion of the site and is oriented in a northeast-southwest direction. Reinforced concrete, metallic debris, and soil mounds were observed on the ground surface throughout this high anomaly concentration area, which may indicate the presence of similar construction-related debris in the subsurface. High concentrations of anomalies were also identified near the southeastern portion of the site.

Three composite surface soil samples were collected from each of three 40 m × 70 m decision units. The composite samples consisted of at least 30 sample increments, collected from a depth of 0 to 2 inches bgs. The surface soil samples were analyzed for explosives residues (SW-846 United States Environmental Protection Agency [USEPA] Method 8330), perchlorate (USEPA Method 6850), and Resource Conservation and Recovery Act (RCRA) metals (SW-846 USEPA Method 6010B/7000).

A DPT drill rig was used to collect continuous soil cores at four locations. Subsurface soil samples were collected from the 2-foot interval immediately above the water table at depths ranging from 3 to 7 feet bgs. All subsurface soil samples were analyzed explosives residues (SW-846 USEPA Method 8330), perchlorate (USEPA Method 6850), and RCRA metals (SW-846 USEPA Method 6010B/7000).

Four temporary groundwater monitoring wells, were installed at depths ranging from 14 to 16 feet bgs in the 4-acre portion of the site. Following well completion and development, groundwater samples were collected from each of the temporary monitoring wells. All samples were analyzed for explosives residues (SW-846 USEPA Method 8330), perchlorate (USEPA Method 6850), and total RCRA metals (SW-846 USEPA Method 6010B/7000).

In collected surface soil samples:

- Explosives residues and perchlorate were not detected.
- Barium, chromium, lead, and mercury were detected, but the concentrations did not exceed both twice the mean Base background levels and regulatory screening criteria.

Subsurface soil results were screened against the NC SSLs (NCDENR, 2010), the adjusted USEPA Adjusted RSLs (USEPA, 2010) and twice the mean Base background subsurface soil concentrations (Baker, 2001). In collected subsurface soil samples:

- Explosives residues and perchlorate were not detected.

- Barium, chromium, and lead were detected in subsurface soil but the concentrations did not exceed both twice the mean Base background levels and regulatory screening criteria.

Groundwater results were compared to the NCGWQS (NCDENR, 2010), USEPA Adjusted Tap Water RSLs (USEPA, 2010) and twice the mean Base background groundwater concentrations (Baker, 2002). In collected groundwater samples:

- Perchlorate was detected in one groundwater sample (ASR2.212-FP2-TW04), at a concentration less than regulatory screening criteria.
- Chromium was the only metal that exceeded both Base background concentrations and regulatory screening criteria.

A HHRS including a risk ratio evaluation was performed based on surface soil, subsurface soil, and groundwater analytical results. Results of the HHRS indicate that there are no unacceptable risks identified for current or likely future receptors exposed to site media. An ecological risk screening was performed based on surface soil and groundwater analytical results. Results of the ecological risk screening indicate that there are no unacceptable risks identified for ecological receptors exposed to site media.

Because no unacceptable human health or ecological risks were identified from exposure to site media, no further environmental characterization sampling was recommended within the 4-acre Focused PA/SI investigation area (CH2M HILL, 2010d). Based on the DGM results, an intrusive investigation of the anomalies identified within the Focused PA/SI investigation area was recommended to assess the nature of the sources of the identified anomalies. As high concentrations of anomalies were identified at the periphery of the Focused PA/SI investigation area and because the entire 16-acre site is planned for MILCON, an investigation including an evaluation of the presence and nature of any subsurface anomalies and MC contamination that may exist was also recommended for the surrounding 12 acres of Site UXO-17, to complete a site-wide PA/SI.

2010 Expanded PA/SI

Additional brush cutting, surveying, DGM, and environmental sampling field activities were completed over the remaining 12 acres of Site UXO-17 in November and December 2010 as a continuation of the PA/SI.

In the 12-acre portion of the site, a total of 4370.6 linear meters along 53 north-south oriented transects were geophysically surveyed across the project site using a single-coil EM61-MK2 system. The area surveyed by the EM61-MK2 was 1.08 acre, or 9 percent of the approximately 12-acre portion of the site. As shown on **Figure 15-2**, 1.03 acres of the area in the southeast corner was inaccessible because it was inside the fence line of the active landfill, and approximately 1.9 additional acres could not be surveyed as a result of debris pits and wetland areas that prevented access. A total of 656 anomalies were identified as representing potential subsurface MEC (CH2M HILL, 2010c). These anomalies were distributed throughout the 12-acre portion of the site. Metal and reinforced concrete debris was observed at multiple locations and may constitute a portion of the selected anomalies.

Environmental sampling within the 12-acre portion of Site UXO-17 consisted of:

- Three surface soil samples each collected from three 30m × 30m DUs using the IS procedure. Surface soil aliquots were collected from a depth of 0 to 2 inches bgs.
- Nineteen surface soil samples were collected using the TR-02-1 sampling method from a depth of 0 to 2 inches bgs.
- Ten subsurface soil samples from soil cores collected using a DPT rig
- One sediment and one surface water sample collected from a co-located site.
- Seven groundwater samples collected from temporary groundwater monitoring wells

Soil and sediment samples were analyzed for explosives residues Including PETN and nitroglycerin) (SW-846 EPA Method 8330/8332), perchlorate (SW-846 EPA Method 6850) and RCRA metals (SW-846 EPA Method 6010B series and 7471A). Surface water and groundwater samples were analyzed for RCRA total metals and dissolved metals (SW-846 USEPA Method 6010B); groundwater samples from MR17-MW10, MR17-MW11, and MR17-MW12 were analyzed additionally for total chromium (SW-846 USEPA Method 6010B) and hexavalent chromium (SW-846 USEPA Method 7196A).

Surface soil results were screened against the North Carolina Soil Screening Levels (NC SSLs) (NCDENR, 2010), the USEPA Adjusted Regional Screening Level (RSLs) (USEPA, 2010) and twice the mean Base background surface soil concentrations (Baker, 2001). In collected surface soil samples:

- Explosives residues (2,4-dinitrotoluene, 2,6-dinitrotoluene , nitrobenzene, 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2,4,6-trinitrotoluene, 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, 3-nitrotoluene, RDX, PETN, and nitroglycerin) and perchlorate were detected in surface soil at concentrations less than regulatory screening criteria in between one and four samples (of 28 total samples).
- Arsenic, chromium, cobalt, iron, and manganese were detected at concentrations greater than twice the Base background values and at least one regulatory screening level.

Subsurface soil results were screened against the NC SSLs (NCDENR, 2010), the adjusted USEPA Adjusted RSLs (USEPA, 2010) and twice the mean Base background subsurface soil concentrations (Baker, 2001). In collected subsurface soil samples:

- Explosives residues (1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 4-ntrotoluene, RDX, and tetryl) were detected in subsurface soil but were detected at concentrations less than regulatory screening levels. Perchlorate was not detected in subsurface soil.
- Aluminum, arsenic, chromium and iron were detected at concentrations greater than twice the Base background values and at least one regulatory screening level.

Sediment results were screened against the NC SSLs (NCDENR, 2010) and the adjusted USEPA Adjusted RSLs (USEPA, 2010). In the collected sediment sample:

- The explosives residue (1-3-dinitrobenzene) and perchlorate were detected but were detected at concentrations less than regulatory screening criteria in the sample.

- Aluminum, arsenic, and chromium were detected at concentrations greater than at least one regulatory screening level in the sample.

Surface water results were compared to the North Carolina Water Quality Groundwater Standards (NCGWQS) (NCDENR, 2010), USEPA Adjusted Tap Water RSLs (USEPA, 2010) and twice the mean Base background groundwater concentrations (Baker, 2002). In the collected surface water sample:

- The explosives residue tetryl was detected but did not exceed regulatory screening criteria. Perchlorate exceeded the Adjusted Tap Water RSL.
- Multiple total and dissolved metals were detected but none exceeded regulatory screening criteria.

Groundwater results were compared to the North Carolina Water Quality Groundwater Standards (NCGWQS) (NCDENR, 2010), USEPA Adjusted Tap Water RSLs (USEPA, 2010) and twice the mean Base background groundwater concentrations (Baker, 2002). In collected groundwater samples:

- The explosives residues 3-nitrotoluene and nitroglycerin were detected at concentrations exceeding Adjusted Tap Water RSLs. Other explosives residues (2,4-dinitrotoluene, 2-amino-4,6-dinitrotoluene, HMX, RDX, and tetryl) and perchlorate were also detected but did not exceed regulatory screening levels.
- Chromium, cobalt, potassium, and dissolved potassium were detected at concentrations exceeding Base background groundwater concentrations and at least one regulatory screening criteria.

Human health and ecological risk screening did not identify any unacceptable risks for human or ecological receptors from any media in the investigation area and no further environmental characterization sampling was recommended. For the 12-acre portion of the site, it was recommended that the anomalies selected as representing potential subsurface MEC be intrusively investigated.

2011 Expanded SI

An Expanded SI for UXO-17 was conducted that included intrusive investigation of geophysical anomalies and saturated response areas representing potential subsurface MEC of 1,310 anomalies and 21 saturated response areas in the 4-acre portion of the site (all target anomalies and saturated response areas identified during the PA/SI) and 70 anomalies in the in the 12-acre portion of the site (approximately 10% of the target anomalies identified in the 2010 Expanded PA/SI). Of the investigated anomalies, 38 were determined to be “no contact” (i.e. the source of the anomalies were not identified).

On March 29, 2011, a single MEC item, a ¼ lb supplemental charge, determined to be a discarded military munitions (DMM) item, was found within a saturated response area in the 4-acre portion of the site. The item was blown-in-place on March 30, 2011. Three post-detonation soil samples were collected and indicated no unacceptable risk to human or ecological receptors. MPPEH items encountered included 5.56mm and 7.62mm blank ammunition and practice mine parts. A total of 48 lbs of range related debris (lifting lugs, banding material, and wire) was recovered. In addition more than 263,000 pounds of cultural items (including construction debris and scrap metal) was recovered.

During the intrusive investigation, a total of six 55-gallon metal drums were identified onsite. One of these drums was partially filled with soil and another drum was filled with a liquid slurry. Upon disturbance of the liquid slurry filled drum, liquid leaked onto the ground surface. Both drums were overpacked and samples collected from the contents. The contents of the soil-filled drum were characterized as non-hazardous waste. When the liquid slurry-filled drum was sampled, it was found that most of the free liquid had evaporated. A sample collected from the contents was found to contain detectable concentrations of metals (arsenic, barium, cadmium, chromium, and lead), VOCs (n-butylbenzene, sec-butylbenzene, iso-propylbenzene, p-isopropyltoluene, naphthalene, n-propylbenzene, 1,2,4-trichorobenzene, 1,3,5-trimethylbenzene, and o-xylene), and SVOCs(2,4-dimethylphenol, 1-methylnapthalene, 2-methylnapthalene). In addition, the contents of the drum were characterized as a hazardous waste due to flammability. Both drums were appropriately disposed. Impacted soil from the spill has been containerized into 35 55-gallon drums and is currently awaiting analysis prior to disposal. Following the discovery of a hazardous substance at UXO-17, the Partnering Team concurred that groundwater a shallow groundwater investigation should be conducted in the vicinity of the former location of the liquid slurry-filled drum.

15.4 Field Activities

15.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

15.4.2 Environmental Sampling and Analysis

Sampling activities will be conducted within Site UXO-17 as follows:

Three additional temporary groundwater monitoring wells will be installed near the former location of the liquid-slurry filled drum. Groundwater characterization samples will be collected from the new monitoring wells as well as five existing temporary monitoring wells. These temporary wells had not been abandoned due to intrusive investigation within the site, since they were located within the exclusion zone.

Well Installation and Groundwater Sampling

Three temporary groundwater monitoring wells (MR17-TW16, -TW17, and –TW18) will be installed in the 4-acre area via hollow stem auger. These three wells and five existing temporary monitoring wells will be sampled, as shown on **Figure 15-3**. One new well will be located near the drum discovery location and two new wells immediately downgradient of the location. Two existing wells are located upgradient of the drum discovery location and three existing wells are located downgradient (MR17-TW09,-TW11, -TW13, -TW14, and –TW15).

Temporary monitoring wells will be installed in three locations (**Figure 15-3).** Each well will consist of 2-inch inner diameter polyvinyl chloride (PVC) well casing, with a 10 feet section of 0.010-inch machine-slotted well screen. The screen will be connected to a new, threaded, flush-jointed, PVC riser casing with the O-rings removed prior to assembly. The wells will be constructed in accordance with *Installation of Shallow Monitoring Wells* SOP in Appendix C of the MRP MPPs (CH2M HILL, 2008a). Optimally, the static groundwater table will intersect 1 to 2 feet below the top of the screen of each monitoring well so that 8 to 9 feet of the screen is below the water. A photoionization detector will be used to determine whether additional sampling (beyond the methods described below) will be required.

The monitoring wells will be developed by the drilling subcontractor to reduce turbidity and allowed to equilibrate to ambient aquifer conditions before static groundwater elevation measurements and environmental groundwater sampling activities begin.

Static groundwater elevations will be measured in the three new wells and all existing wells at UXO-17 prior to purging and sampling activities at any well. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot using a water level indicator or an oil/water interface probe, as appropriate. The indicator will be decontaminated after use in each well.

Groundwater samples will be collected as previously described in **Section 9.4.2**.

Groundwater samples will be analyzed for VOCs (by EPA Method SW-846 8260) and SVOCs (by EPA Method SW-846 8270) at a fixed-base laboratory (**Table 15-1**). The contents of the drum, based on waste characterization sampling, were likely composed of either a kerosene, a paint thinner, or a combination of both based on the flashpoint, C-range hydrocarbons, VOCs, and SVOCs detected. VOC and SVOC analysis will be conducted to evaluate potential impacts from the drum.

TABLE 15-1
Summary of Sampling Program at UXO-17

Sample Media	Sample ID Number	Sample Depth/Location and Rationale	Analysis	
			VOCs	SVOCs
Groundwater	MR17-GW09-11B, MR17-GW11-11B, MR17-GW-13-11B through MR17-GW18-11B	Low-flow purge methodology will be used to collect groundwater samples Will allow for the measurement of VOC and SVOC concentrations in groundwater	8	8

15.4.3 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the UFP-SAP (**Appendix B**).

15.4.4 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-17 includes reacquisition and investigation of up to 587 remaining anomalies that were identified in the 12-acre portion of the site during the PA/SI as representing potential subsurface MEC (**Figure 15-2**). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission

The intrusive investigation at Site UXO-17 will be conducted in accordance with Amendment 2 to the ESS for Site UXO-17 (ESS-117) (CH2M HILL, 2010e), approved by MARCORSYSCOM on 10 March 2011.

Operations in Populated and Sensitive Areas

Site UXO-17 is not located in a populated area. No jurisdictional wetlands or habitat for threatened or endangered species are located within the site.

Exclusion Zones and Separation Distances

The MGFD for the site is the fuze MTSQ M564. Exclusion zone parameters are provided in **Table 15-2** and are shown on **Figures 15-4** (for the primary MGFD) **and 15-5** (for the contingency MGFD).

TABLE 15-2
Exclusion Zone Parameters for Site UXO-17

Scenario	Item	Net Explosives Weight (NEW)	MSD (feet)	MSD for Public and Nonessential Personnel (feet)	IBD (feet)	PTR (feet)
Unintentional Detonation (Hand Excavation)	Fuze MTSQ M564	RDX 0.06025 lb	18	65	NA	NA
Unintentional Detonation (mechanical Excavation)	Fuze MTSQ M564	RDX 0.06025 lb	18	305	NA	NA
Intentional Detonation	Fuze MTSQ M564	RDX 1.06025 lb (includes donor charge)	305	305	NA	NA
Onsite Consolidation, Storage, and Re-inspection	MPPEH	1 lb	NA	NA	291	175

NOTES:

All exclusion zone parameters are based on the fragmentation distances in DDESB TP 16

IBD – Inhabited Building Distance
MPPEH – Material Presenting a Potential Explosive Hazard
MSD – Minimum Separation Distance
MTSQ –Mechanical Time Super Quick
NA – Not Applicable
PTR – Public Transportation Route

Legend
- Site UXO-17 Boundary
- Base Boundary

N

0 200 400 800 Feet

1 inch = 400 feet

Figure 15-1
UXO-17 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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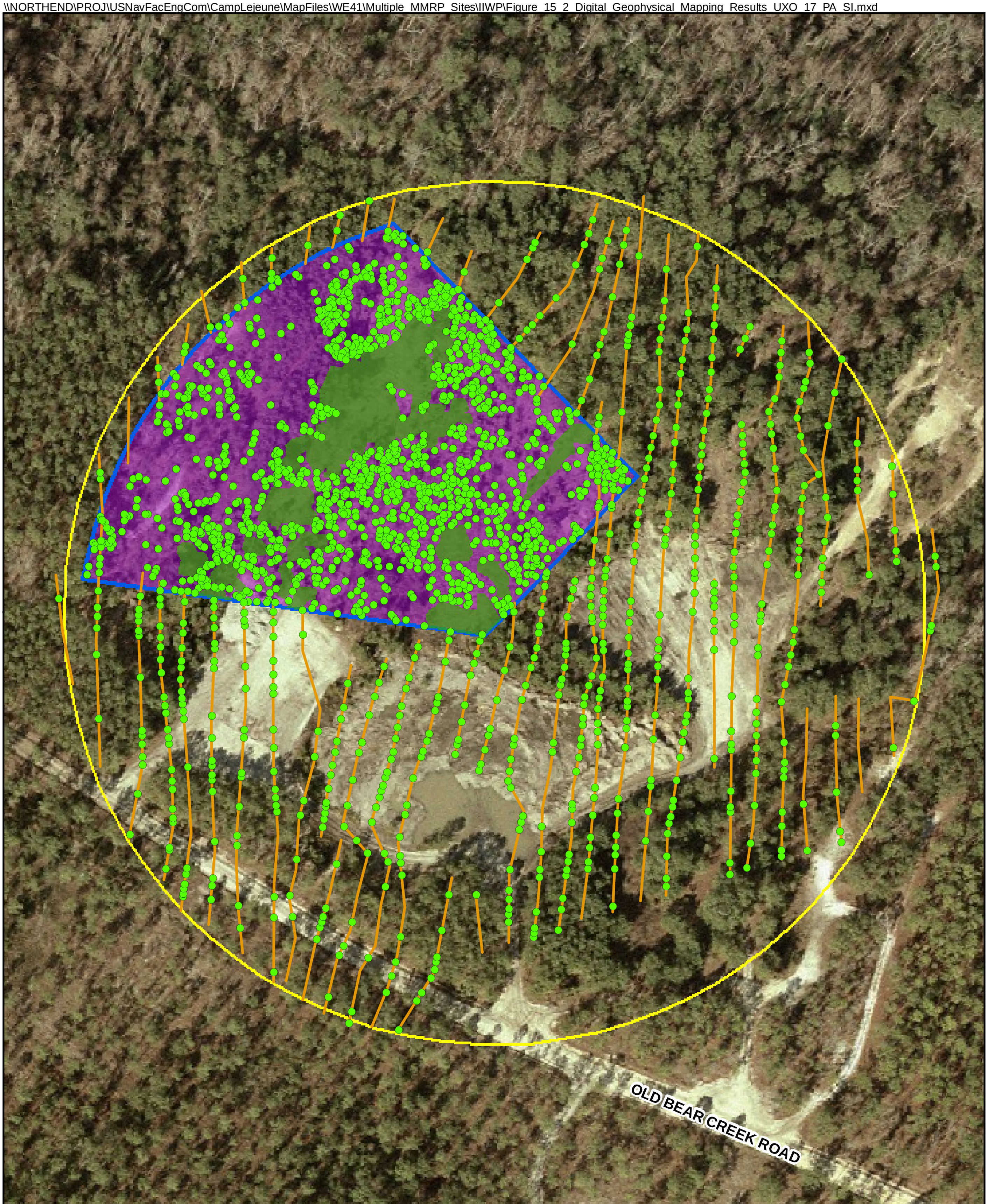


Legend
- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transects
- Saturated Response Area
- 100% DGM Survey
- Focused MILCON PA/SI Investigation (4-acre area)
- Site UXO-17 Boundary

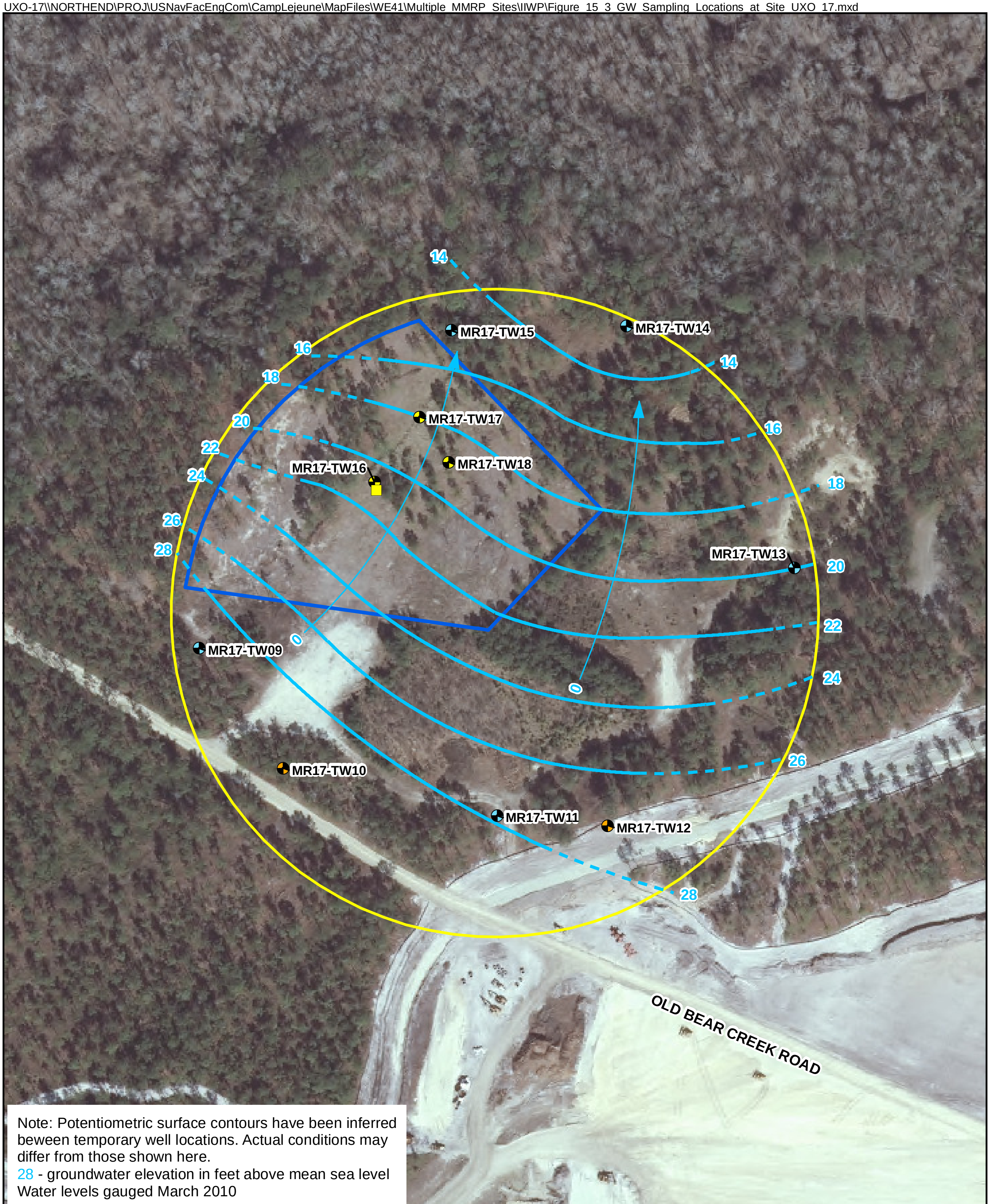
N

0 75 150 300 Feet

1 inch = 150 feet

Figure 15-2
Site UXO-17 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL



Note: Potentiometric surface contours have been inferred beween temporary well locations. Actual conditions may differ from those shown here.
28 - groundwater elevation in feet above mean sea level
Water levels gauged March 2010

Legend
- Liquid Slurry Filled Drum Discovery Location
- Existing Monitoring Well
- Proposed Monitoring Well
- Water level measurements only
- Potentiometric Contour (dashed where inferred)
- Groundwater Flow Direction
- Focused MILCON PA/SI Investigation (4-acre area)
- Site UXO-17 Boundary

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 15-3
Groundwater Sampling Locations at Site UXO-17
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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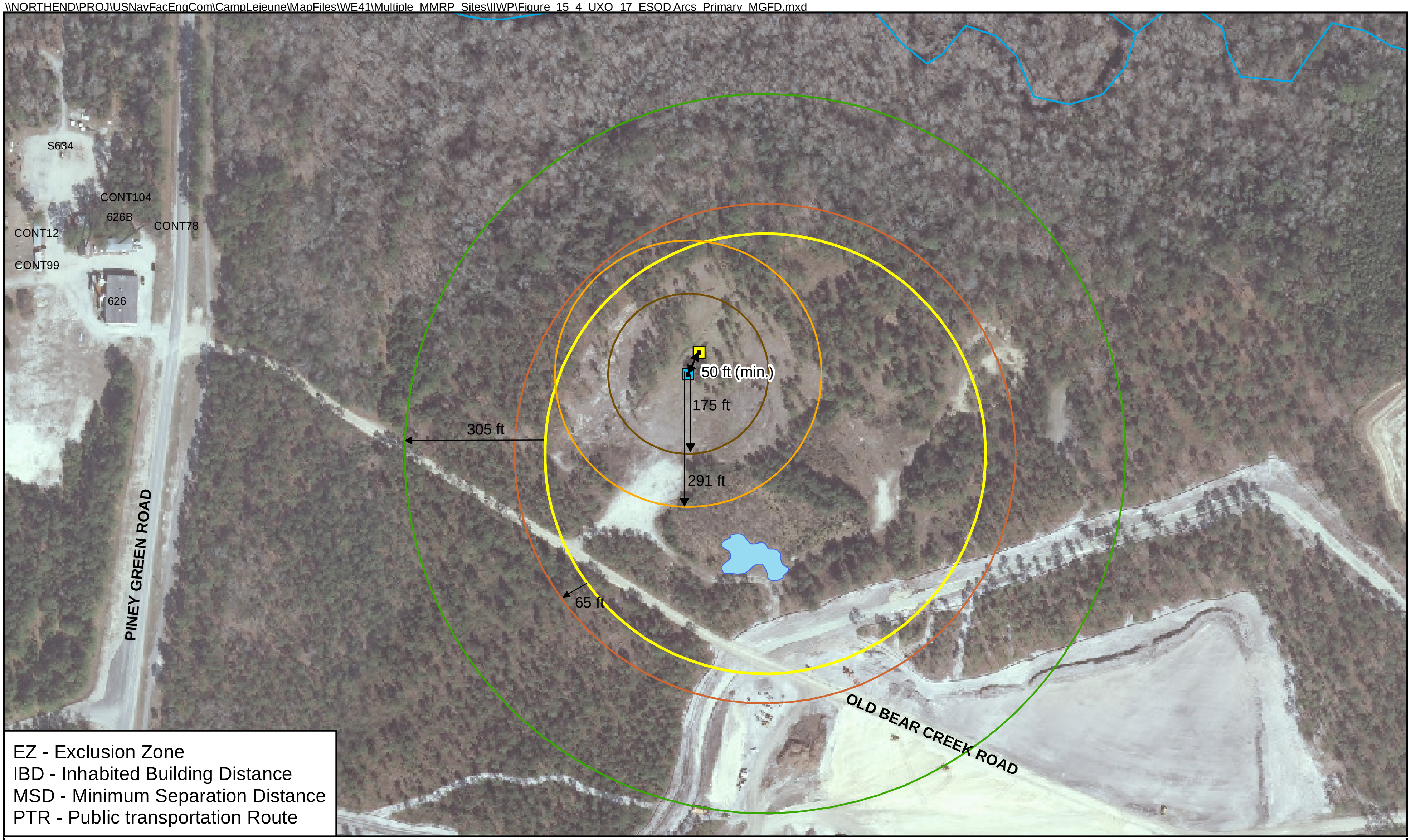

EZ - Exclusion Zone
IBD - Inhabited Building Distance
MSD - Minimum Separation Distance
PTR - Public transportation Route

Legend

- MPPEH Scrap Collection Point
- Non-MPPEH Scrap Collection Point
- EZ/MSD Unintentional Detonation (Hand Excavation) = 65 ft
- EZ/MSD Unintentional Detonation (Mechanical Excavation)/Intentional Detonation (Hand and Mechanical Excavation) = 305 ft
- MPPEH Scrap Collection Point IBD = 291 ft
- MPPEH Scrap Collection Point PTR = 175 ft
- Surface Water Centerline
- Site UXO-17 Boundary
- Pond

N

0 150 300 Feet

1 inch = 300 feet

Figure 15-4
Site UXO-17
ESQD Arcs for Primary MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

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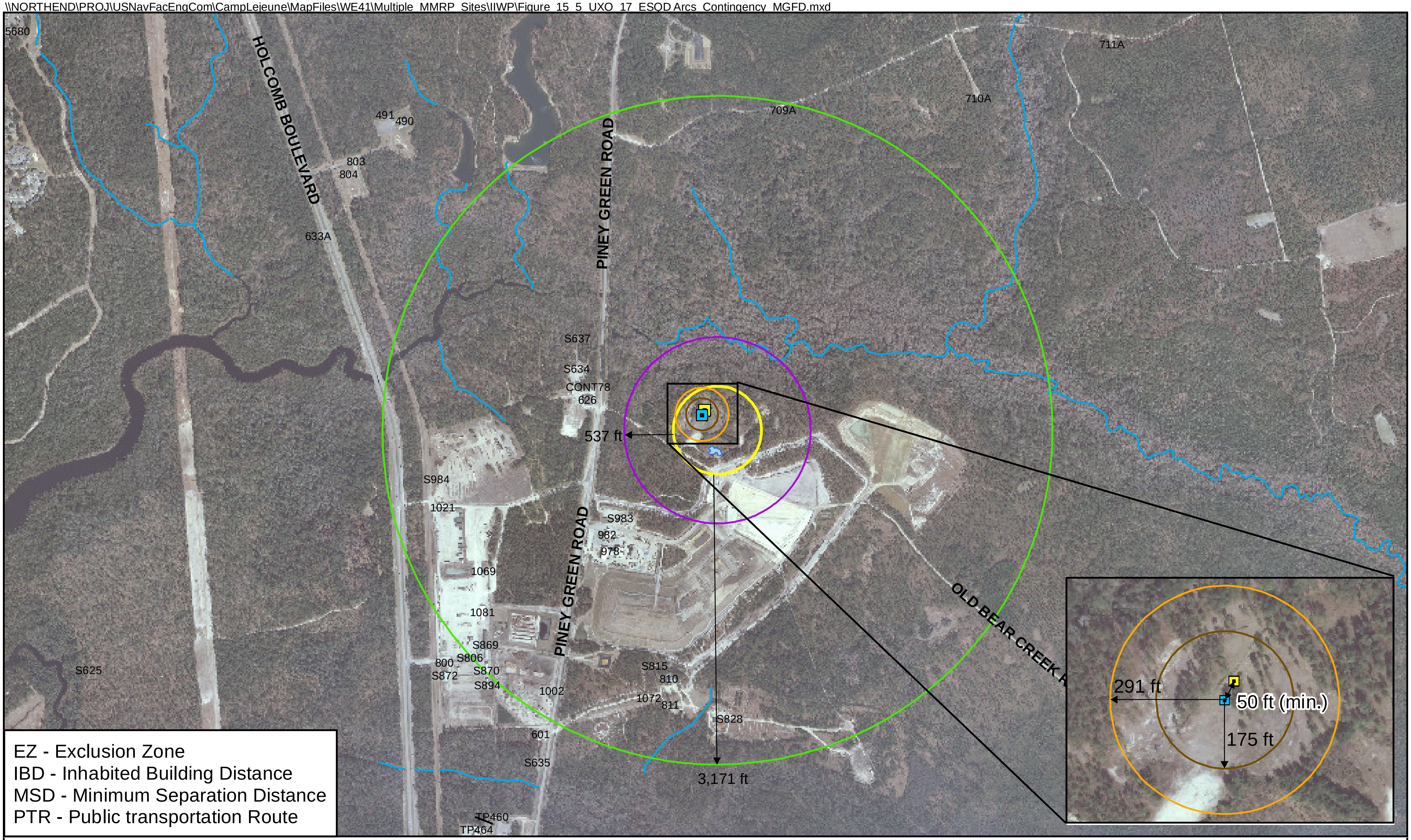

EZ - Exclusion Zone
IBD - Inhabited Building Distance
MSD - Minimum Separation Distance
PTR - Public transportation Route

Legend

- MPPEH Scrap Collection Point
- Non-MPPEH Scrap Collection Point
- EZ/MSD for Intentional Detonation= 3,171 ft
- EZ/MSD for Unintentional Detonation = 537 ft
- MPPEH Scrap Collection Point IBD = 291 ft
- MPPEH Scrap Collection Point PTR= 175 ft
- Surface Water
- Site UXO-17 Boundary
- Pond

N

0 750 1,500 3,000 Feet

1 inch = 1,500 feet

Figure 15-5
Site UXO-17
ESQD Arcs for Contingency MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

SECTION 16

UXO-21—Former D-Area Gas Chamber (2D MAR DIV) (ASR #2.204)

16.1 UXO-21 Site Location and Description

Site UXO-21 is approximately 17 acres in size and located within the active installation of MCB CamLej west of Sneads Ferry Road and, south of Lyman Road (**Figure 16-1**). Sneads Ferry Road crosses from north to south through the east side of the site while an unnamed gravel road crosses from north to south through the west side of the site.

The area surrounding Site UXO-21 mainly includes woodlands and fields. The woodlands include jurisdictional wetlands and surround an unnamed tributary of Cogdels Creek, which is located approximately one-third of a mile south of Site UXO-21. Cogdels Creek in turn discharges into the New River downstream of the site.

16.2 Site Geology and Hydrogeology

Soil borings from the PA/SI and the Expanded SI ranged from 5 to 25 feet bgs (CH2M HILL, 2010f, 2010g). The predominant lithology in the interior area of site UXO-21 consists of poorly graded, silty sand interbedded with a lesser amount of clayey and gravelly sands. Soil boring logs from the of the exterior investigation area of the site indicate sediments ranging from clay and silt to silty sand. Soil coloration was generally light gray to tan and orange across most of the site, becoming light gray to brown and black in borings located at the southern end of the site. Cobbles with a black to gray silty sand matrix were recovered from boring MR21-MW05 between 6 and 10 ft bgs. MR21-MW05 is located in a drainage area near a road at the southwestern end of the site. Excluding the cobbles found at MR21-MW05, the shallow soil at UXO-21 is consistent with the undifferentiated formation (Cardinell, et al., 1993).

The water table of the surficial aquifer occurs in the undifferentiated formation at this site. Site-specific hydrogeologic information was derived from the installation of ten shallow temporary monitoring wells during the Expanded SI. The monitoring wells were screened in the surficial aquifer with screen bottom depths ranging between 12 and 20 ft bgs. The depth to surficial groundwater at the site ranged from 3.38 to 18.80 ft below top-of-casing in April 2010. The potentiometric surface of the water table in April 2010 indicated that groundwater generally flowed to the west-southwest with an average horizontal hydraulic gradient of 0.16 ft/ft (CH2M HILL, 2010d). Groundwater flow directions converge toward a surface drainage feature located in the southern portion of the site.

16.3 Site History and Previous Investigations

16.3.1 History

In May 2007, as part of the initial PA/SI, CH2M HILL completed an Archival Records Search Report for the site (CH2M HILL, 2010f). A map showing the exact location of the former gas chamber was not located, and historic maps dating between 1946 and 1984 showed no structures in the immediate area of Site UXO-21. The *Closed Range List and Maps for MCB Camp Lejeune Report (*Lowder, 2005*)* only identifies a period of use for this site of 1970.

Because this facility was used as a gas chamber, only Chemical Warfare Training Agents (Tear Gas) would have been used for gas mask confidence drills. However, other chemical training including War Gas Identification Sets and Riot Control Hand Grenades may have been used in the area surrounding the gas chamber.

16.3.2 2007 Preliminary Assessment/Site Inspection

In June and July 2007, a PA/SI was conducted for 5 acres in the interior of the site. The site boundary of UXO-21 was originally believed to encompass a 5-acre area surrounding what was believed to be the location of the Former D-Area Gas Chamber. Due to the lack of information regarding the exact location of the Former D-Area Gas Chamber, the site boundary was later increased to a 17-acre site. The initial PA/SI was conducted based on the original site boundaries for UXO-21.

DGM was performed along the cleared transects of the interior 5-acre investigation area of Site UXO-21 in order to evaluate the frequency and distribution of geophysical anomalies that could potentially represent subsurface MEC. A total of 1,193 linear meters along 22 north-south oriented transects were geophysically surveyed across the project site a single-coil EM61-MK2 system. The area surveyed by the EM61-MK2 was 0.29 acre, or 5.8 percent of the approximately 5-acre site. As shown on **Figure 16-2**, in the interior 5-acres of the site, approximately one-third of the site could not be surveyed as a result of a creek and wetland area that prevented access. A total of 138 anomalies were identified as representing potential subsurface MEC (CH2M HILL, 2010f) in the interior 5-acre area. A majority of the selected anomalies were located in the southern half of the interior 5-acre area.

Environmental sampling within the 5-acre portion of Site UXO-21 consisted of:

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

Soil samples were analyzed for Target Compound List (TCL) VOCs by USEPA Method OLM04, TCL SVOCs by USEPA Method OLM04, TAL Metals by USEPA Method ILM04, and Tear gas constituents (CN and CS) by USEPA Method SW-846 8270C, groundwater samples were additionally analyzed for dissolved metals by USEPA Method ILM04.

Human health and ecological risk screening did not identify any unacceptable risks for human or ecological receptors from any media in the investigation area and further investigation of the interior 5-acre investigation area of Site UXO-21 was not recommended. The PA/SI for the 5-acre area of investigation recommended that the anomalies selected as representing potential subsurface MEC be intrusively investigated and that the PA/SI be expanded to the remaining 12 acres of the site.

16.3.3 2010 Expanded SI

The Expanded SI conducted in February, March, and April 2010, evaluated the potential presence and nature of effects on the environmental media resulting from historical munitions use at the site and the presence of geophysical anomalies that may represent subsurface MEC in the remaining exterior 12 acres of Site UXO-21.

A DGM survey covered approximately 10 percent (approximately 1.06 acres) of the exterior investigation area of Site UXO-21. Duplicate survey data were recorded for approximately 2 percent of the total area of Site UXO-21. Cultural items (such as power lines, construction materials, and roadways) were present at the exterior investigation area of Site UXO-21, which partially hindered the DGM survey. The DGM survey yielded a total of 738 geophysical anomalies representing potential subsurface MEC in the exterior 12-acres of the site (CH2M HILL, 2010g). The greatest density of anomalies was found near Sneads Ferry Road and the service road in the southern portion of the site. The DGM area and the distribution of anomalies identified as representing potential subsurface MEC are shown on **Figure 16-2**.

Environmental sampling within the 12-acre portion of Site UXO-21 consisted of:

- Thirty surface soil samples collected using the TR-02-1 approach at a depth interval of 0 to 2 inches bgs
- Six surface water and six sediment samples collected at co-located sites MR21-SW01 through MR21-SW06 and MR21-SD01 through MR21-SD06, from the unnamed drainage features in the northern and southern portions of the 12-acre area of Site UXO-21
- Ten groundwater samples collected from temporary groundwater monitoring wells

Samples were analyzed for explosives residues (SW-846 USEPA Method 8330); perchlorate (SW-846 USEPA Method 6850), TCL total metals (SW-846 USEPA Method 6010B and 7470); TCL VOCs (USEPA SW-846 Method 8260B); SVOCs, TCL, including CS and CN (USEPA SW-846 Method 8270C). Surface soil samples were additionally analyzed for PETN (SW-846 USEPA Method 8330) and Nitroglycerin (SW-846 USEPA Method 8330). Surface water and groundwater samples were additionally analyzed for dissolved TAL metals (USEPA SW-846 Method 6010B and 7470).

After HHRS, it was determined that constituents detected in the surface soil, groundwater, surface water, and sediment from the exterior investigation area of UXO-21 are not expected to pose a risk to potential human receptors. Additionally, no significant risks to populations of ecological receptors were identified within the 12-acre area of Site UXO-21 (CH2M HILL, 2010d). Because no unacceptable human health or ecological risks were identified from exposure to site media, no further environmental characterization sampling was recommended.

Based on the DGM results, the report recommended that an intrusive investigation be performed to assess the nature of the identified geophysical anomalies. Because no unacceptable human health or ecological risks were identified from exposure to site media, no further environmental characterization sampling was recommended. The need for additional sampling of MC will be re-evaluated based on the results of the intrusive investigation.

16.4 Field Activities

16.4.1 Site Preparation and Restoration

Refer to **Section 3.2**.

16.4.2 Post-Detonation Soil Sampling and Analysis

Post-detonation samples may be collected in accordance with **Section 3.4**. Sample analyses and QA/QC requirements are described in the QAPP (A**ppendix C**).

16.4.3 MEC Intrusive Investigation

MEC intrusive investigation at Site UXO-21 includes reacquisition and investigation of 876 remaining anomalies that were identified as representing potential subsurface MEC/MPPEH at the site during the PA/SI (**Figure 16-2**). (138 anomalies were identified within the interior 5 acres of the site, and 738 identified in the remaining 12 acres of the site). Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 24 inches, as described in **Section 4**. Processing and disposal of MEC, MPPEH, and MDAS will also be completed in accordance with **Section 4**.

Explosives Safety Submission]

The intrusive investigation at Site UXO-21 will be conducted in accordance with the ESS for Site UXO-21 (AGVIQ-CH2M HILL, 2009), approved by DDESB 16 September 2009 and Amendment 1 to the ESS for Site UXO-21 (CH2M HILL, 2010), which added onsite construction support for road construction to the intrusive activities, approved by MARCORSYSCOM 1 April 2010.

Operations in Populated and Sensitive Areas

Site UXO-21 is not located in a populated area. However, sensitive habitats include jurisdictional wetlands in portions of UXO-21. MEC operations in these areas will be conducted in accordance with the EPP (**Section 8**) to be protective of these sensitive areas and all threatened and endangered species.

Exclusion Zones and Separation Distances

Because there are non-fragmenting munitions potentially at Site UXO-21, MCEs have been used as the basis of exclusion zones. The primary MCE for the site is the Signal Flare, M22A1. Exclusion zone parameters are provided on **Table 16-1** and are shown on **Figures 16-3** (for the primary MGFD) and **16-4** (for the contingency MGFD).

TABLE 16-1
Exclusion Zone Parameters for Site UXO-21

Operation	Sited as	ES	Basis	ESQD[1] (feet)	
Primary MCE (Signal Flare, M22A1)				**Primary MCE**	**Contingency MCE**
Manual operations[1]	Unintentional detonation	UXO teams	K40 of the MCE[4]	25	42
Manual operations[1]	Unintentional detonation	Public and non-essential personnel	K40 of the MCE	25	42
MEC treatment up to 1 lb NEW[2] (Primary MCE); 1.5 lb NEW[2] (Contingency MCE: Smoke Grenade, AN-M8)	Intentional detonation[2]	Public and all personnel	K328 of the NEW of the MCE[4]	353	375
MPPEH Collection					
MPPEH collection area for onsite consolidation, storage, and re-inspection (up to 1 lb NEW)[6]	Metal Storage Container (e.g., 55-gallon drum or CONEX box)	Non-essential personnel in structures	Inhabited Building Distance (IBD)[7]	291	291
		Non-essential personnel in the open	Public Transportation Route (PTR) [7]	175	175

Table notes:
1. Manual operations involve excavating anomalies with hand tools.
2. Combined NEWs of the donor chare and the MEC will not exceed 1.25 lb for the primary MEC and 1.5 lb for the contingency MCE. There is no known published data that provides
3.MPPEH storage will allow the separate storage of MPPEH up to 1 lb.
4. This distance can be reduced by employing engineering controls authorized by DDESB TP-16.
5. Based on Table 7-9, Ordnance Publication (OP)-5, Volume 1, 7th Revision (NAVSEA, 2010). PTR is 60 percent of IBD.

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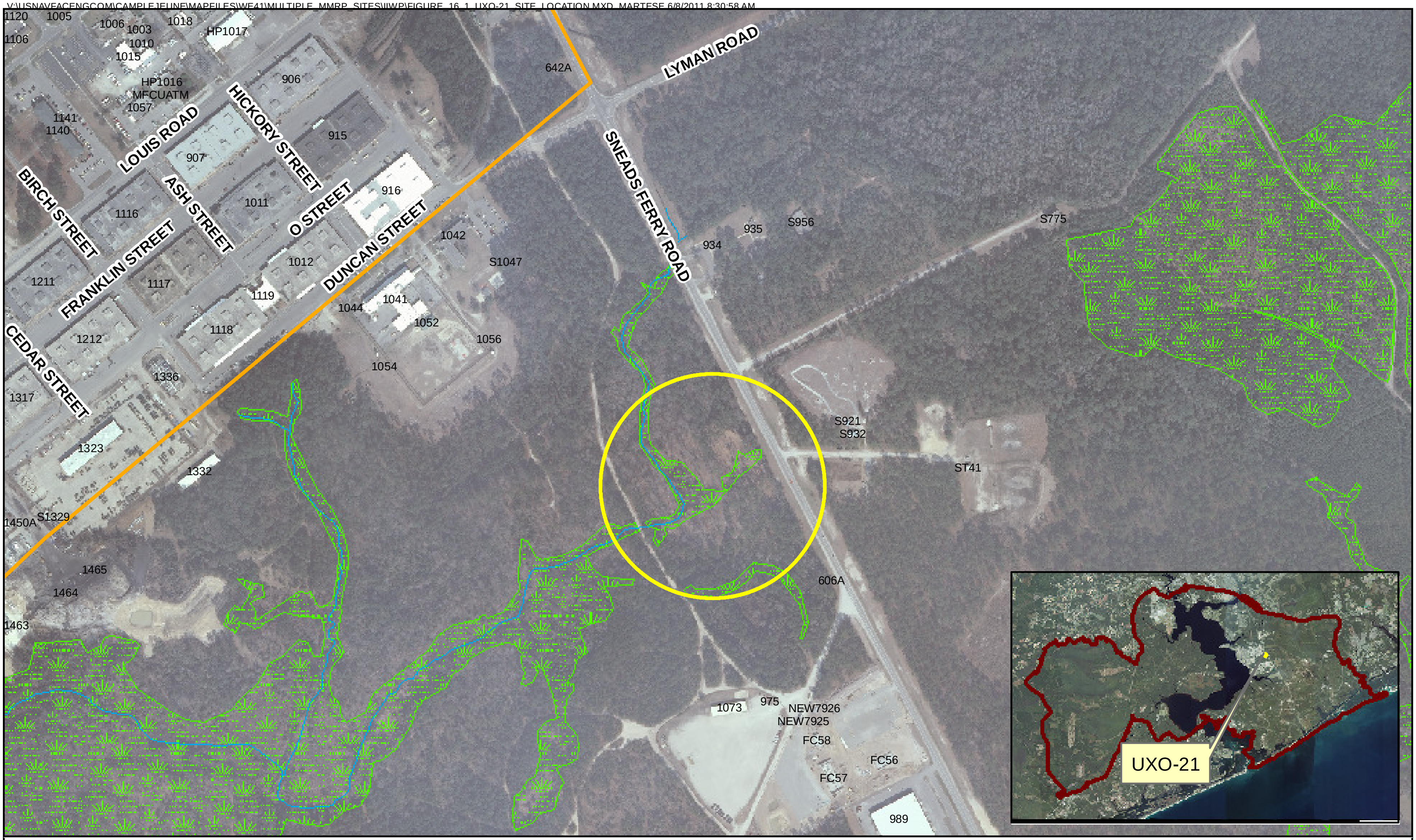

Legend
- Surface Water
- Jurisdictional Wetlands
- Site UXO-21- Former D Area Gas Chamber (2D MAR DIV) (ASR #2.204)
- Hadnot Point Boundary
- Installation Boundary

N

0 300 600 1,200 Feet

1 inch = 600 feet

Figure 16-1
UXO-21 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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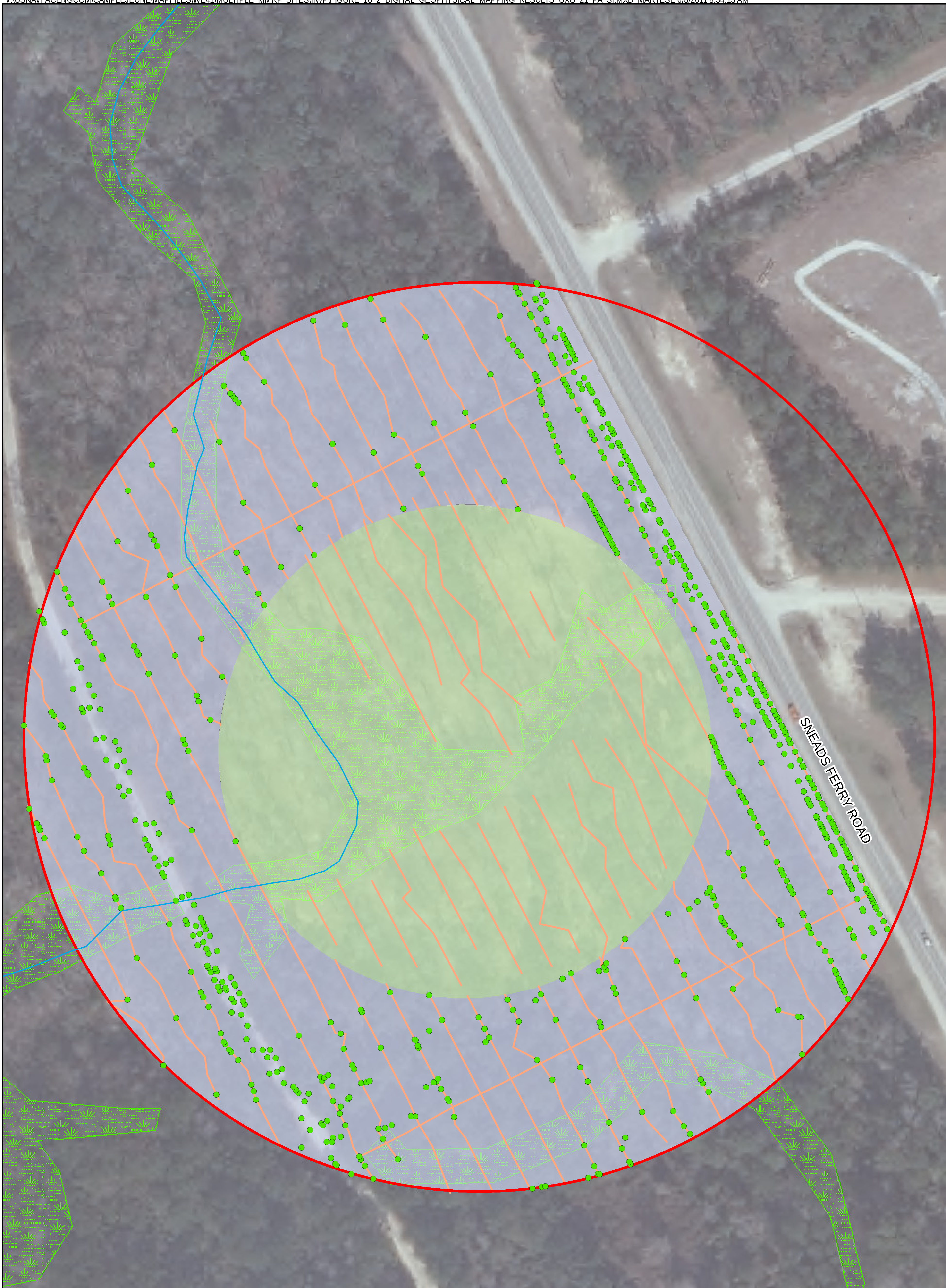

Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- Surface Water
- DGM Transects
- Jurisdictional Wetlands
- Site UXO-21 Boundary
- Phase I Investigation Area
- Phase II Investigation Area

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 16-2
Site UXO-21 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\Figure_16_3_UXO_21_ESQD Arcs_Primary_MGFD.mxd

Legend

- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point PTR (175 ft)
- MPPEH Collection Point IBD (291 ft)
- Unintentional Detonation EZ, TSD, Public, and Non-Essential Personnel (25 ft)
- Intentional Detonation EZ, All Personnel (353 ft)
- Surface Water
- Site UXO-21 Boundary

N

0 125 250 500 Feet

1 inch = 250 feet (1:3,000)

Figure 16-3
Site UXO-21
ESQD Arcs for the Primary MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

\\NORTHEND\PROJ\USNavFacEngCom\CampLejeune\MapFiles\WE41\Multiple_MMRP_Sites\IIWP\Figure_16_4_UXO_21_ESQD_Arcs_Contingency_MGFD.mxd

Legend
- MPPEH Collection Point
- MDAS Collection Point
- MPPEH Collection Point PTR (175 ft)
- MPPEH Collection Point IBD (291 ft)
- Unintentional Detonation EZ, TSD, Public, and Non-Essential Personnel (42 ft)
- Intentional Detonation EZ, All Personnel (375 ft)
- Surface Water
- Site UXO-21 Boundary

N

0 125 250 500 Feet

1 inch = 250 feet (1:3,000)

Figure 16-4
UXO-21 Site Location
ESQD Arcs for the Contingency MGFD
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

SECTION 17

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Appendix A
Site-specific Health and Safety Plan

Final

Health and Safety Plan

Intrusive Investigation for Military Munitions Response Program Sites UXO-01(ASR #2.23), UXO-01 (ASR 2.79a, b, and c), UXO-02, UXO-07, UXO-11, UXO-14, UXO-17, and UXO-21

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order WE-41

September 2011

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract No. N63470-08-D-1000

Prepared by

CH2MHILL

Knoxville, Tennessee

Acronyms and Abbreviations

μg/m³	micrograms per cubic meter
AHA	Activity Hazard Analysis
ASR	Archival Search Report
Base	Marine Corps Base Camp Lejeune
CFR	Code of Federal Regulations
CO	carbon monoxide
COC(s)	contaminant(s) of concern
CPR	cardiopulmonary resuscitation
CRZ	Contamination Reduction Zone
CWM	chemical warfare material
dBA	decibels, A-weighted
DDESB	Department of Defense Explosives Safety Board
DEET	N,N-diethyl-meta-toluamide
DOT	U.S. Department of Transportation
EM	environmental manager
EPA	U.S. Environmental Protection Agency
ERC	emergency response coordinator
ESBG	Environmental Services Business Group
ESQD	explosives safety quantity-distance
ESS(s)	Explosives Safety Submission(s)
EZ	Exclusion Zone
FID	flame ionization detector
GFCI(s)	ground fault circuit interrupter(s)
HAZWOPER	hazardous waste operations and emergency response
HEPA	high-efficiency particulate air (filter)
HITS	Hours and Incident Tracking System
HSE	health, safety, and the environment
HSSE	Health, Safety, Security, & Environment
HSP	Health and Safety Plan
IDW	investigation-derived waste
IRF	Incident Report Form
kV	kilovolt(s)
LO/TO	lockout/tagout
lpm	liters per minute
lx	lux
MC	munitions constituents
MCB CamLej	Marine Corps Base Camp Lejeune
MEC	munitions and explosives of concern
MGFD(s)	munition(s) with the greatest fragmentation distance

mm	millimeter(s)
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MSDS(s)	Material Safety Data Sheet(s)
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PID	photoionization detector
PIM	potentially infectious material
PM	project manager
PPE	personal protective equipment
ppm	parts per million
PTSP(s)	Pre-Task Safety Plan(s)
RCA(s)	Root Cause Analysis (Analyses)
RHSM	Responsible Health and Safety Manager
RMSF	Rocky Mountain spotted fever
SBO(s)	Safe Behavior Observation(s)
SC	safety coordinator
SCBA	self-contained breathing apparatus
SOP(s)	standard operating procedure(s)
SZ	Support Zone
USACE	U.S. Army Corps of Engineers
UV	ultraviolet
UXO	unexploded ordnance
UXOSO/UXOQCS	UXO safety officer/UXO quality control specialist
VO	Virtual Office (CH2M HILL intranet system)
WP	Work Plan

Contents

Attachments

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 (PPE) has been selected based on the project-specific hazard assessment.

Original Plan

RHSM Approval: Carl Woods **Date**: 6/16/11

Field Operations Manager Approval: **Date:**

Revisions

Revisions Made By: **Date:**

Description of Revisions to Plan:

Revisions Approved By: **Date:**

SECTION 1

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 Card
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 his or her work in a safe manner
- Stop work immediately to correct any unsafe condition that is encountered
- 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 managers and employees are expected to strive to meet the project-specific health, safety, and the environment (HSE) goals outlined below. The project 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 11 specific HSE 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 this HSP through education, delegation, and teamwork
- 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
- Achieve health and safety excellence

SECTION 2

Applicability

This HSP applies to:

- All CH2M HILL project personnel, 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 personnel 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 members and visitors when they are physically on the work site. The work site consists of 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. It will be amended or revised as project activities or conditions change or when supplemental information becomes available. This HSP adopts, by reference, the enterprise-wide core standards and standard operating procedures (SOPs), as appropriate. In addition, this HSP may adopt procedures from the project Work Plan (WP) 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 project team members and subcontractors must sign the employee sign-off form presented 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).

SECTION 3

General Project Information

3.1 Project Information and Background

Project Number: 418824

CLIENT: NAVFAC Atlantic

PROJECT/SITE NAME: LANTDIV CLEAN 1000 CTO-WE41 / MCB CamLej, Intrusive Investigation for Military Munitions Response Program Sites UXO-01(ASR #2.23), UXO-01 (ASR 2.79a, b, and c), UXO-02, UXO-07, UXO-11, UXO-14, UXO-17, and UXO-21.

SITE ADDRESS: Multiple sites, each located within the boundary of Marine Corps Base (MCB, or the Base) Camp Lejeune (CamLej) in Jacksonville, Onslow County, North Carolina

CH2M HILL PROJECT MANAGER: Keith LaTorre/KNV

CH2M HILL OFFICE: Knoxville, Tennessee

DATE HSP Prepared: 5/13/2011

Date(s) of Site Work: July-August 2011

3.2 Site Background and Setting

Construction of MCB CamLej began in 1941 with the objective of developing the "World's Most Complete Amphibious Training Base". Construction of the Base started at Hadnot Point, where the major functions of the Base are centered. During World War II, MCB CamLej was a training area to prepare Marines for combat. MCB CamLej was again used for training during the Korean and Vietnam conflicts, and the Gulf War. MCB CamLej is host to five Marine Corps commands and one Navy command. In addition, MCB CamLej provides support and training for the following tenant commands: Headquarters Nucleus; Second Marine Expeditionary Force; Second Marine Division; Second Marine Force Service Support Group; Second Marine Surveillance, Reconnaissance, and Intelligence Group; Sixth Marine Expeditionary Brigade; the Naval Hospital; and the Naval Dental Clinic. All of the real estate and infrastructure are owned, operated, and maintained by the host command. The mission of MCB CamLej is to maintain combat-ready units for expeditionary deployment.

MCB CamLej is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean. The Atlantic Ocean forms the southeastern boundary of the Base. The western and northwester boundaries are U.S. Route 17 and State Route 24, respectively. The city of Jacksonville, North Carolina, is immediately northwest of MCB CamLej.

Land use surrounding MCB CamLej is varied, with industrial properties concentrated along the northern boundary. Estuaries along the coast support commercial fishing, and residential resort areas are adjacent to MCB CamLej along the Atlantic Ocean.

A summary of the site histories is presented below. A more-comprehensive summary of each site is presented in the WP, *Site-specific Work Plan Addendum for Intrusive Investigation for Military Munitions Response Program Sites: UXO-01 - Former Live Hand Grenade Course (ASR#2.23), UXO-01 - Former B-3 Gas Chamber (ASR#2.79a,b, and c), UXO-02 - Former Unnamed Explosive Contaminated Range (ASR #2.201), UXO-7 – Former Practice Hand Grenade Course (ASR #2.77a and #2.77b), UXO-11 - Former B-5 Practice Hand Grenade Course (ASR #2.81), UXO-14 - Former Indoor Pistol Range (ASR #2.199) and Former Gas*

Chamber (ASR #2.200) , UXO-17 – Former Firing Position 2 (ASR #2.12), and UXO-21 - Former D-Area Gas Chamber(2D MAR DIV) (ASR #2.204).

UXO-01,Former Live Hand Grenade Course (Archive Search Report [ASR]#2.23) - Archival review indicates that the area comprising this site was a former live hand grenade course used for troop training; the area is not associated with an active impact area, range, range fan, safety danger zone, or with the disposal of military munitions. The site was used during World War II for troop maneuvers that included the use of fragmentation, offensive, and practice grenades. Disposal of munitions and or burial of munitions is not reported or suspected at the site. The use of chemical warfare material (CWM) is unlikely, based on the archival review.

UXO-01, Former B-3 Gas Chamber (ASR#2.79a, b, and c) - The Former B-3 Gas Chamber was operated between 1953 and 1958 (U.S. Army Corps of Engineers *Final Range Identification and Preliminary Range Assessment* as [USACE], 2001) and involved the use of chemical warfare training agents, such as tear gas. There is no evidence that CWM would have been used during training activities; however, the area surrounding gas chambers was often used for other chemical training. Therefore, it has been suggested that chemical agent identification sets and riot control hand grenades may have been used at the Former B-3 Gas Chamber (USACE, 2001). Materials potentially present in the surface soils at Site UXO-01 may include tear gas canisters and degradation byproducts of chloroacetophenone and 0-chlorobenzylidenemaloonitrile.

UXO-02, Former Unnamed Explosive Contaminated Range (ASR#2.201) - Site UXO-02 was identified in the *Final Range Identification and Preliminary Range Assessment* as an unnamed range of unspecified use on a 1973 range map and on another range overlay maps as an "…unknown UXO [unexploded ordnance] contaminated area…" (USACE, 2001). The 1946 range overlay map indicated that the location was Mortar Range "L-2", established in a 1945 Camp Training Order. However, by March 1946, it was disestablished and no longer used for firing live ammunition. Although USACE concluded that 60millimeter (mm) and 81mm mortars (practice, high explosive white phosphorus, illumination) may have been fired on Mortar Range "L-2" (USACE, 2001), a former Range Control Officer stated that Mortar Range "L-2" was used a platoon/squad maneuver range with mortar projectiles used for illumination. As such, 60mm and 81mm illumination mortars and 40mm practice grenades would have been used on Mortar Range "L-2." The firing position for Mortar Range "L-2" was along the southern boundary of UXO-02, with impact trajectories due north into the New River.

UXO-07, Former Practice Hand Grenade Course (ASR #2.77a and 2.77b) - The area of Site UXO-07 closest to McHugh Boulevard appears to have served as recreational fields from the 1950s through the 1980s, while the southern area was primarily wooded. As shown on a 1984 existing conditions map, the southern area of Site UXO-07 appears to overlap the Former 5th Area Gun Park. This gun park was a large parking area with concrete pads and small sheds where 105mm and 155mm howitzers of the 10th Marines (Artillery Regiment) were stored along with the trucks that pulled the howitzers. The sheds also were used to perform maintenance and to store equipment for the howitzers. Historical aerial photographs indicate that by 1989 the northern portion of the site had been developed and looked very similar to current conditions. Building HP503 in the northern area had not yet been constructed in 1989.

UXO-11, Former B-5 Practice Hand Grenade Course (ASR #2.81) - Historical range overlay maps show Site UXO-11 first appearing as a practice hand grenade course in 1954 (USACE, 2001). The *Final Range Identification and Preliminary Range Assessment* also references a map from September 1, 1953 and states that although the range appeared on the 1954 range overlay map, Site UXO-11 was in use only during 1953. To date, no other historical reference to this area being used as a practice hand grenade course has been identified. Existing conditions maps from 1947 and 1953 include the area designated as Site UXO-11. These maps show a mockup structure (Building 507), presumably used for training exercises, within the site boundaries. This building is also visible on aerial photographs from 1946, 1948, and 1951.

Building 507 does not appear on maps after 1953. All aerial photographs from 1946, 1948, 1951, 1962, and 1989 show that the area designated as Site UXO-11 was clear of all vegetation except grass.

UXO-14, Former Indoor Pistol Range (ASR #2.199) and Former Gas Chamber (ASR # 2.200)- The Indoor Pistol Range first appears on existing conditions maps in 1950 as Building RR-53 According to the *Final Range Identification and Preliminary Range Assessment*, the pistol range was present on base maps until 1996. The Indoor Pistol Range appears in the 1962 and 1989 historical aerial photographs. According to Base Range Safety Officer, Duane Richardson, the Indoor Pistol Range was only used for small arms training.

The gas chamber first appeared on the 1950 existing conditions maps as Building RR-63; it was labeled as a gas chamber until 1954. After 1954, Building RR-63 was used for storage and was shown on maps until 1965. However, on the 1962 historical aerial photograph, the area is completely overgrown, and Building RR-63 is not visible. The 1989 historical aerial photograph also shows the area as being heavily wooded. According to the *Final Range Identification and Preliminary Range Assessment,* it is assumed that tear gas was used at this facility.

UXO-17, Former Firing Position 2 (ASR#2.212)- UXO-17 was reportedly used as a firing position from the 1950s through at least 1985. The current MCB CamLej Range Safety Officer stated that 105-mm and 155-mm howitzers were used at this site to fire practice rounds into the K-2 and G-10 Impact Areas. In addition, the MCB CamLej Range Control Officer stated that 4.2-inch mortars, 175-mm guns, 8-inch howitzers, and 120-mm mortars also may have been used, with unused projectile propellant being burnt on the ground. No CWM was reported to have been used at this site. Based on concrete, metal drums, and other scrap metal encountered during intrusive investigation of a portion of the site, it is likely that portions of the site were also used for disposal of construction debris.

UXO-21, Former D-Area Gas Chamber (2D MAR DIV) (ASR #2.204)- In May 2007, as part of an initial Preliminary Assessment/Site Inspection, CH2M HILL completed an archival records search report for the site. A map showing the exact location of the former gas chamber was not located, and historic maps dating between 1946 and 1984 showed no structures in the immediate area of Site UXO-21. The *Closed Range List and Maps for MCB Camp Lejeune Report (*Lowder, 2005*)* identifies only 1970 as the period of use for this site. Because this facility was used as a gas chamber, only chemical warfare training agents (tear gas) would have been used for gas mask confidence drills. However, other chemical training, such as war gas identification sets and riot control hand grenades, may have been conducted in the area surrounding the gas chamber.

See the Site Map at the end of this section for the site locations.

3.3 Description of Tasks

All CH2M HILL and subcontractor employees engaging in hazardous waste operations or emergency response (HAZWOPER) tasks shall receive appropriate training as required by 29 Code of Federal Regulations (CFR) 1910.120 and 29 CFR 1926.65 (or if required by subcontract). Personnel who have not met these training requirements shall not be allowed to engage in hazardous waste operations or emergency response activities. Tasks that fall under HAZWOPER requirements are listed in section 3.3.1.

Sites UXO-01(ASR#2.23 and ASR#2.79a,b, and c) , UXO-02, UXO-07, UXO-11, UXO-14, UXO-17, and UXO-21 have the potential to contain munitions and explosives of concerns (MEC) and/or environmental contamination with munitions constituents (MC). Because of the historical activities that took place within these project areas, additional assessment is being conducted to accomplish the following activities:

- MEC intrusive investigation of selected geophysical anomalies.

- If a controlled detonation is necessary, collection of composite surface soil samples will using the TR-02-1 sampling method in the crater (location of detonation) and collection of composite surface soil samples from outside the crater using the incremental sampling method.
- Environmental sampling at Site UXO-02, Site UXO-11, UXO-17, and Site UXO-14.
- Site restoration.

3.3.1 HAZWOPER-regulated Tasks

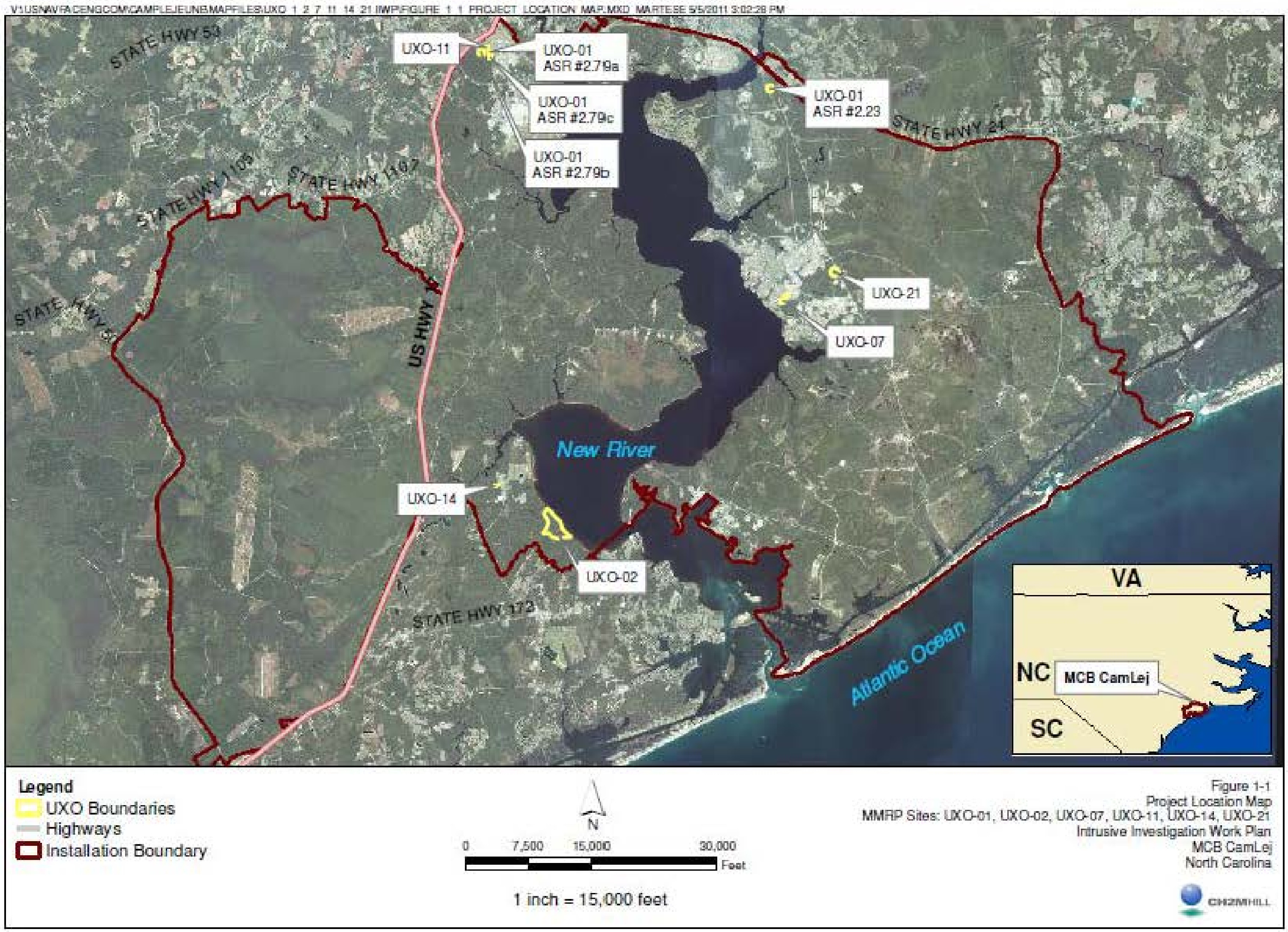
- MEC intrusive investigation
- MEC demolition and disposal (blasting operations)
- Vegetation clearing oversight
- Direct-push technology soil borings
- Monitoring well installation
- Soil, sediment, surface water, and groundwater sampling
- Investigation-derived waste (IDW) management

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. Because the tasks listed below do not involve exposure to safety or health hazards associated with the hazardous waste operations, HAZWOPER training or medical requirements do not apply.

TASKS	CONTROLS
• Mobilization/ Demobilization • Utility locate	• 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



V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\UXO_1_2_7_11_14_21\IWP\FIGURE_1_1_PROJECT_LOCATION_MAP.MXD MARTESE 5/5/2011 3:02:28 PM
STATE HWY 53
UXO-11
UXO-01
ASR #2.79a
UXO-01
ASR #2.79c
UXO-01
ASR #2.79b
UXO-01
ASR #2.23
STATE HWY 24
STATE HWY 1105
STATE HWY 1107
STATE HWY 50
US HWY 17
UXO-21
UXO-07
New River
UXO-14
UXO-02
STATE HWY 172
Atlantic Ocean
VA
NC
MCB CamLej
SC
Legend
UXO Boundaries
Highways
Installation Boundary
N
0 7,500 15,000 30,000
Feet
1 inch = 15,000 feet
Figure 1-1
Project Location Map
MMRP Sites: UXO-01, UXO-02, UXO-07, UXO-11, UXO-14, UXO-21
Intrusive Investigation Work Plan
MCB CamLej
North Carolina
CH2MHILL

SECTION 4

Project Organization and Responsibilities

4.1 Client

Client Contact
David Cleland, PG
NAVFAC Mid-Atlantic
NC IPT, Code: OPQE
6506 Hampton Blvd
Norfolk, Virginia 23508-1278
Direct: (757) 322-4734
Fax: (757) 322-4805
david.t.cleland@navy.mil

Base Contact
Charity Rychak
Camp Lejeune - EMD
Building 12
Marine Corps Base Camp Lejeune, NC 28542-0004
Direct (910) 451-9385
Fax: (910) 451-5997
charity.rychak@usmc.mil

4.2 CH2M HILL

4.2.1 Project Manager

Name: Keith LaTorre
CH2M HILL Office: KNV
Telephone Number: (865) 769-3204
Cellular Number: (865)323-3300

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 members, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this HSP:

- 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
  - Ensuring HSE submittals, subcontract agreements, and appropriate site-specific safety procedures are in place and accepted before field mobilization
- Ensure copies of training and medical monitoring records, and site-specific safety procedures are being maintained in the project file and are accessible to site personnel
- Provide oversight of subcontractor HSE practices in accordance with the site-specific safety plans and procedures
- Manage the site and interfacing with third 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 RHSM

Name: Carl Woods
CH2M HILL Office: CIN
Telephone Number: (513) 889-5771
Cellular 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 (AHAs)
- Review and evaluate subcontractor site-specific safety procedures for adequacy before the subcontractor's field operations begin
- 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
- Participate in incident investigations, lessons learned, and loss and near-loss reporting

4.2.3 Project Environmental Manager

Name: Nancy Ballantyne
CH2M HILL Office: DEN
Telephone Number: (720) 286-5561
Cellular Number: (303) 885-9954

The project environmental manager (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
- Provide environmental compliance and environmental management expertise and advice to the project team as needed during the course of the project

4.2.4 SC

Name: TBD
CH2M HILL Office:
Telephone Number:
Cellular Number:

The SC is responsible for verifying that the project is conducted safely, including the following specific obligations:

- Verify that this HSP is current and amended when project activities or conditions change
- Verify that CH2M HILL site personnel and subcontractor personnel read the HSP and sign the Employee Sign-Off Form, before beginning field activities

- Verify that CH2M HILL site personnel have completed any required specialty training (for example, fall protection or 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 before the subcontractor's field operations begin
- Act as the project Hazard Communication Coordinator and perform the related responsibilities outlined in this HSP
- Act as the project emergency response coordinator (ERC) and perform the related responsibilities outlined in this HSP
- Post the Occupational Safety and Health Administration (OSHA) job-site poster 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 in accordance with 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 third-party interfaces
- Verify appropriate 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 this HSP and maintain all air monitoring records in project file
- Maintain HSE records and documentation
- Facilitate OSHA or other government agency inspections, including accompanying inspectors 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
- Document all oral health and safety-related communications in project field logbook, daily reports, or other records.

4.2.5 UXO Safety Officer /UXO Quality Control Specialist

Name: TBD
CH2M HILL Office:
Telephone Number:
Cellular Number:

The UXO safety officer/UXO quality control specialist (UXOSO/UXOQCS) for this project will report directly to the PM on issues pertaining to the MEC operations at the sites. The UXOSO/UXOQCS will have the following safety and health-related responsibilities:

- Report directly to the CH2M HILL PM
- Manage the funding, manpower, and equipment necessary to safely conduct site operations
- Review and become familiar with the project WP and this HSP
- Provide copies of the WP and HSP to site personnel
- Review the scope of work and ensure that the required safety and health elements are addressed in this HSP and/or WP
- Coordinate the assignment of personnel and ensure that the personnel and equipment provided meet the requirements of the WP and this HSP
- Ensure that project quality, safety and health procedures area implemented
- Conduct early detection and identification of potential problem areas, including safety and health matters, and institute corrective measures
- Interface directly with the PM and advise him of safety and health matters related to conduct of the site operations
- Act as the On-Scene Incident Commander in a MEC emergency, notifying and coordinating with offsite emergency and medical response agencies.

4.3 CH2M HILL Subcontractors

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

Utility Locator Subcontractor: TBD Subcontractor Contact Name: TBD Telephone: TBD	UXO Subcontractor: TBD Subcontractor Contact: Telephone:
Drilling Subcontractor: TBD Subcontractor Contact: Telephone:	Laboratory Subcontractor: TBD Subcontractor Contact Name: TBD Telephone: TBD
IDW Disposal Contractor: TBD Subcontractor Contact: Telephone:	Data validation Subcontractor: TBD 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 their operations
- Notify the SC of any accident, injury, or incident (including spills or releases) 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 this CH2M HILL HSP, subcontractor HSPs, and subcontractor AHAs, and sign appropriate sign-off forms
- Develop 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. Each AHA shall identify the principal steps of the activity, potential health and safety hazards for each step, and recommended control measures for each identified hazard. In addition, a list 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 provided.

4.4 Employee Responsibilities

All personnel are responsible for safe and healthy operations. This concept is the foundation for involving all CH2M HILL and subcontractor 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 achieving 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
- Complete an HSE orientation before 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, During employee orientation, each employee will be informed of his/her authority to do so.

4.5 Client Contractors

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

Contractor: TBD
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 such a 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 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 develop and implement corrective actions
  - If necessary, stop affected CH2M HILL work until contractor corrects the condition or practice
  - 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 developing 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 developing 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.

SECTION 5

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, this HSP, and CH2M HILL's safety requirements. 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 include, but are not 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 CH2M HILL Environmental Services Business Group (ESBG) employees, employees working on ESBG 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 managers and supervisors. 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 the condition(s) or practice(s) using the Observed Hazard Form, provided as an attachment to this HSP, and require corrective action.

If necessary, stop subcontractor's work using the Stop Work Order Form, provided as an attachment to this HSP, until corrective actions are implemented for observed serious hazards or conditions. Update the Observed Hazard Form to document that corrective actions have been taken. The subcontractor is responsible for developing 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 when any CH2M HILL employee observes unsafe conditions or failure of the subcontractor to adhere to its safe-work practices, or observes a condition or practice that may result in a release or violation of an environmental requirement. 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 personnel 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, 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 until adequate corrective measures are implemented. Consult the Contract Administrator to find out what the contract dictates for actions to pursue in event of subcontractor non-compliance, such as work stoppage, back charges, progress payments, removal of subcontractor manager, monetary penalties, or termination of subcontractor for cause.

5.4 Incentive Program

Each project team 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 a supervisor, telling the supervisor about an incident, coming up with a safer way to get the work done, or stopping a team 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 team and requires effective communication between employees, supervisors, and managers. Accident prevention requires a proactive policy on near misses, close calls, unsafe conditions, and unsafe practices. All personnel must report any situation, practice, or condition that might jeopardize the safety of the project. 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.
- Details of the incident or situation will be recorded by the SC in the field logbook or on the Observed Hazard Form if a subcontractor was involved.

SECTION 6

Safety Planning and Change Management

6.1 Daily Safety Meetings and Pre-Task Safety Plans

Daily safety meetings are to be attended by all project personnel 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 supervisors 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 and the 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 this 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

This HSP addresses all known activities and associated hazards. As work progresses, if significant changes are identified that could affect health and safety at the site, coordinate with the RHSM to decide whether an HSP update is necessary.

The following are examples of changes that may require a revision to the plan:

- Change in the CH2M HILL staff
- New subcontractor to perform work
- New chemicals brought to site for use
- Change in scope of work or addition of new tasks
- Change in contaminants of concern (COCs) or change in concentrations of COCs
- New hazards or hazards not previously identified that are not addressed in this HSP

6.3 Agency Inspection Guidance

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

Agency inspections (for example, OSHA, U.S. Environmental Protection Agency [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 HSP addresses things such as 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 should contact the RHSM to update this HSP if they encounter hazards 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 (up from 36,000 inspections).
- The definition for "Repeat Violations" will encompass the past 5 years instead of 3 years.
- OSHA directors can only reduce fines by a maximum of 30 percent.
- Some fines will be increased by between $3,000 and $4,000 per violation.

- Proposed legislature would raise serious fines from $7,000 to $12,000.
- Proposed legislature would raise willful fines from $70,000 to $250,000.

SOP HSE-201 addresses agency inspections in detail, and the attached **Agency Inspection Target Zero Bulletin** provides a good summary of the inspection process and what to do if a representative from an agency such as OSHA or EPA shows up at the site. It is critical that the PM or or the RHSM be immediately notified if an inspector arrives onsite (and the EM if the inspection is environmental-related); they can help facilitate and make additional notifications.

The Target Zero Bulletin should be posted at the field trailer or kept with this HSP /Environmental Plan; make it a topic at a safety meeting and keep it readily available in the event of an inspection.

SECTION 7

Project Hazard Analysis

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

- Elimination of the hazards (use remote sampling methodology to avoid going into a confined space)
- Substitution (for example, reduce exposure to vapors by using of 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)
- 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
- COCs.

7.1 Activity Hazard Analysis

An AHA must be developed for each CH2M HILL job activity. The AHA shall define the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard. In addition, a list of the equipment to be used to perform the activity, inspection requirements to be performed, and training requirements for the safe operation of the equipment listed must be identified. Workers will be briefed on the AHA before performing the work and their input will be solicited before, during, and after the performance of work to further identify the hazards posed and control measures required.

The following hazard controls and applicable CH2M HILL core standards and SOPs should be used as a basis for preparing AHAs.

AHAs prepared for CH2M HILL activities are 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 procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires that either a new AHA be prepared or an existing AHA be revised.

Table 1 – General Activity Hazard Analysis

Potential Hazard / Project Activity	Mobilization/ Demobilization	Utility Locate	MEC Investigation Demolition and Disposal	Vegetation Clearance	Monitoring Well Installation /Direct-push Technology Soil Boring	Soil, Sediment, Surface Water, & Groundwater Sampling	IDW Management
Arsenic			X		X	X	X
Biological Hazards	X	X	X	X	X	X	X
Chain Saw/Brush Cutter				X			
Chemical Hazard	X		X		X	X	X
Drilling					X		
Drum Handling/Sampling	X		X		X	X	X
Earthmoving Equipment	X		X				
Electrical Safety		X	X	X	X	X	X
Excavations	X		X		X		
Explosives Usage or Munitions Response (MR)			X				
Fall Protection					X		
Field Vehicles	X	X	X	X	X	X	X
Fire Prevention	X	X	X	X	X	X	X
Forklifts			X		X		X
Groundwater Sampling						X	
Hand & Power Tools	X	X	X	X	X	X	X
Knife Use							
Lead			X		X	X	X
Lockout/Tagout (LO/TO)			X	X	X		
Manual Lifting	X	X	X	X	X	X	X
MEC/Material Potentially Presenting an Explosive Hazard (MPPEH)	X	X	X		X	X	X
Noise			X	X	X	X	
Pressure Washing					X		
Rigging					X		
Temperature Extremes	X	X	X	X	X	X	X
Traffic Control		X	X	X	X	X	X
Ultraviolet Light exposure (sunburn)	X	X	X	X	X	X	X
Utilities (underground/overhead)	X	X	X		X		
Welding and Cutting					X		
Working around Material Handling Equipment					X	X	

SECTION 8

General Hazards and Controls

This section discusses 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 that all requirements are met.

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.
- 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 if they are exposed to PIM. This examination consists of the following procedures:

- Documenting the exposure
- Testing the exposed employee's and the source individual's blood (with consent)
- 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
- Store paper or other combustibles away from flammables
- Use secondary containment and lipped shelving that is secured
- Have a fire suppression system available

8.2.1 General 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 liquids or 120 gallons (545.5 liters) of combustible liquids shall be stored in any one storage cabinet. No 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 (5,000 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 be located at least 20 feet (6.1 meters) away from any building.
- Signs prohibiting 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 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 according to local or national fire codes. Verify that appropriate storage provisions are in place before starting work.
- **NOTE**: Counties and cities also may have requirements specific to storing these chemicals. In addition, 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 EM to find out whether the project chemicals are subject to these standards.

- Injection chemicals must be stored in a designated, secured area with spill prevention capabilities. Review material safety data sheets (MSDSs) or other information to identify potential incompatible materials. Incompatible materials shall not be stored together. All containers must be 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 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, or adjusting controls can divert attention from the road. Take the time to park and perform these tasks when parked rather than while driving.
- Ensure that 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 pickups have different vision challenges and handling characteristics than smaller vehicles.

8.4 Electrical Safety

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

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 are listed below. 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 the online Awareness Level Electrical Safety Training, located on the CH2M HILL Virtual Office (VO) intranet system.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until LO/TO procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage before use. Do not use defective electrical equipment and remove it 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 that 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 cannot be used
  - Client requires such a program to be implemented
  - Business group decides to implement the 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-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 kilovolts (kV) or less, and 10 feet (3 meters) plus 0.4 inches (1.0 centimeter) 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.
- 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 the vehicle if working adjacent to active roadway.
- Familiarize yourself with rental vehicle features before 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, if equipped
- Always wear seatbelt while operating vehicle.
- Adjust headrest to proper position.
- Tie down loose items if using a van or pickup 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 an emergency. If not possible, carry a phone.
- Have a designated place for storing the field vehicle keys when not in use.
- Ensure backup 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
  - 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 work 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:

- Perform site work during daylight hours whenever possible.
- Practice good housekeeping at all times in all project work areas.
- Establish common paths of travel and keep them 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.
- Designate specific areas for the proper storage of materials.
- Store tools, equipment, materials, and supplies in an orderly manner.
- Store neatly or remove scrap and unessential materials from the work area as work progresses.
- Provide containers for collecting trash and other debris and empty them at regular intervals.
- Clean up all spills quickly; clean oil and grease 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 the 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.
- Check the work area to identify any existing problems or hazards.

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 provided 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 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 list it 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 hazard communication training using the chemical-specific training form included as an attachment to this HSP
- 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 AHA or written procedure is in place that covers the necessary safety precautions (work practices, PPE, and training).
- Knife users have been trained and follow the AHA.

Responsibilities	• Supervisors, with assistance from the SC, are responsible for funding and ensuring that the correct tool is being used, employees wear the proper PPE when using knives, and they have reviewed this policy. • Employees are responsible for having and using the proper PPE while performing an activity requiring the use of a knife. Employees are also responsible for understanding the proper use of a knife.
Glove Requirements	• In general, Kevlar cut-resistant gloves are to be worn when using a knife in an occupational setting. • Other types of gloves may be required and will be identified within the AHA / written procedure. Example - Leather gloves may be worn when using the acetate sleeve cutter.
Training (Ref. VO for additional hand safety topics)	All employees who will use a knife must be trained in its proper use: • When using a knife, always cut away from yourself. • Many tasks using a utility knife require a knife edge but not a sharp point. For these tasks you can add protection against puncture wounds by using a rounded-tip blade. • If you use a folding knife, it must be a locking blade type. • Never use a knife that will fold under pressure. • If you use a fixed blade knife, make sure there is a handle guard to keep your hand from slipping forward. Also, make sure the handle is dry and non- greasy/slippery to assure a better grip. • When cutting, make the force of the cut carry the blade away from any part of your body. If you have a peculiar situation where this is not possible, protect yourself with a leather apron, or other material placed between you and the blade. Consider putting the material to be cut in a vise or other holding device. • If you carry a fixed blade knife, use a sheath or holder. • Store utility knives safely, retract the blade or sheath and open blade before storing. Never leave a knife with the blade exposed on the floor, on a pallet, on a work surface, or in a drawer or cabinet. • Keep your knife sharp. A dull blade requires you to use more force to cut and consequently increases the risk of slip or mistake. • Knives used on the job, but not carried with you , must be properly stored when not in use • Never use a defective knife. • Utility knife blades are brittle and can snap easily. Don't bend them or apply side loads to them by using them to open cans or pry loose objects. Use the knife only to cut. It was not designed to work as a prybar, screwdriver, hole punch, and other assorted functions that make work seem easier. • If you get cut, seek medical attention to treat the injury by notifying your supervisor and contacting WorkCare at 1-866-893-2514.

Examples of preferred tools and Kevlar cut resistant gloves are illustrated below:






A safety spring provides for automatic blade "shoot-back" into the handle when contact w/cutting surface is lost

Stay focused on the cutting job. It only takes a second of inattention with a sharp blade to produce a serious cut. Letting the mind wander or talking with others while using a knife greatly increases the risk of an accident and injury. If you are interrupted while working with a knife, stop cutting, retract the blade, and place the knife down on a secure surface before dealing with the interruption. Never continue cutting while distracted.

As always, utilize the hierarchy of controls and first attempt to engineer out the hazard and frequently ask whether the right tool is available for the job.

8.10 Lighting

Lighting shall be evaluated when conducting work inside buildings, confined spaces, or other areas/instances where supplemental light may be needed (such as 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) of illumination.
- Construction work conducted inside buildings should be provided with at least 55 lx of illumination.
- The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lx illumination 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 procedures 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.
- Mechanical lifting devices, such as forklifts. cranes, hoists, and rigging. hand trucks. and trolleys, are the preferred means of lifting heavy objects.
- Personnel shall seek assistance when performing manual lifting tasks that appear beyond their physical capabilities.
- In general, when planning and performing manual lifts, assess the situation before you lift; use good lifting and body positioning practices; and use good carrying and setting down practices.
- All CH2M HILL workers must complete training in proper manual lifting either through the New Employee Orientation or through Manual Lifting training 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. The practices below shall be followed:

- Keep hands away from nose, mouth, and eyes during work.
- Keep areas of broken skin (chapped, burned, etc.) covered.
- Wash hands with soap and water before 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 DOT. Hazardous wastes that may be shipped offsite are also defined as hazardous materials by DOT. Other wastes may also be DOT-classified as hazardous materials. To confirm whether a material or waste is a DOT-classified 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 personnel who are associated with the shipment of hazardous materials, including receiving hazardous materials, preparing profiles or manifests, packaging hazardous wastes, labeling, or transporting hazardous materials by road, are classified as HazMat employees (note that 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 Health, Safety, Security, & Environment (HSSE) website on the VO.

All hazardous materials that are shipped (for example, via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by a trained staff member. If the material is a product that is being shipped (for example, calibration gas), use the HazMat ShipRight tool on the CH2M HILL VO (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 HazMat employee understand the security risks involved with transporting hazardous materials.
- All transporters of hazardous materials must be prequalified by a Contracts Administrator who evaluates 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 driver's and company information on the form with the driver.
- If there is suspicious or unusual behavior (for example, driver without credentials, evasive answers) or any discrepancies are identified, do not offer or accept the shipment, and immediately notify the PM or the RHSM.

Employees responsible for shipping hazardous 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 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
- 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 MR 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 VO.

SECTION 9

Project-specific Hazard Controls

This section discusses the 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. Always consult the appropriate CH2M HILL SOP to make sure that 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*)

Arsenic is considered to be a "confirmed human carcinogen." CH2M HILL is required to control employee exposure to arsenic when exposures are at or above 5.0 micrograms per cubic meter ($\mu g/m^3$), or if there is the possibility of skin or eye irritation from arsenic. 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 (includes project-specific training and the computer-based training on CH2M HILL's VO, *Arsenic Exposure)*
- Record keeping requirements

If air monitoring indicates a potential exposure to arsenic at the action level concentrations, notify the RHSM to ensure these program elements have been adequately addressed. Full implementation of SOP HSE-501, *Arsenic*, also will be required. Other exposure control measures are as follows:

- 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.
- Avoid skin and eye contact with liquid and particulate arsenic or arsenic trichloride.
- Select respiratory protection and other exposure controls based on the most recent exposure monitoring results obtained from the competent person.
- Review the arsenic fact sheet included as an attachment to this HSP.

9.2 Chainsaws

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

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

9.2.1 Equipment

Only chainsaws equipped with a spark arrestor and fully functioning chain brake or "safety chain" shall be used. The following safety equipment shall be readily available while operating a chainsaw:

- Chainsaw operator's manual
- Fully stocked first aid kit
- Multipurpose fire extinguisher
- Grounded extension cord approved for outdoor use and a GFCI for electrically powered chainsaws
- Approved safety gasoline container and funnel or flexible nozzle for refueling gasoline-powered chainsaws
- Sledge hammer and non-metallic wedges when necessary to prevent pinching of the chain

9.2.2 PPE Requirements

The following PPE shall be worn while operating chainsaws:

- Safety glasses with side shields and face shield to prevent injury from wood chips, sawdust, or other flying objects
- Hard hat with properly fitted suspension to prevent head injury from falling debris
- Steel-toed safety shoes or boots to prevent foot injury from falling objects and accidental contact with the moving chain
- Hearing protection to prevent permanent damage to hearing. Ear muffs or plugs will have an assigned decibel noise reduction rating —the higher the rating, the greater the protection provided
- Non-leather, fabric work gloves to prevent hand injury from abrasions, splinters, and cuts
- Clothing that is well-fitted and free of loose edges that could become entangled in the saw
- Protective chaps or leggings that cover the area from the groin to about 2 inches (5.08 centimeters) above the ankles. These chaps are made from synthetic fabrics designed to prevent the running saw chain from coming in contact with the operator's legs.

9.2.3 Safe Operation

The following safe operation guidelines shall be followed regardless of the purpose for using a chainsaw:

- Inspect the chainsaw before use.
- Hold chainsaws firmly with both hands, with thumbs and fingers encircling both chain saw handles.
- Stand slightly to the left side of the saw, out of the plane of the cutting chain and guide bar to reduce the risk of injury in the event of a kickback.
- Position the saw so that it is between the waist and mid-chest level. Avoid overreaching or cutting above the mid-chest height.
- Maintain a full throttle setting while cutting. Chainsaws are designed to be run at full speed.
- Always be aware of what is in the saw's downward path after the cut.
- Do not attempt to cut material that is larger than the guide bar of the saw.
- Avoid cuts that will cause the chainsaw to jam. Always cut into the compression wood first until the cut starts to close, then cut from the other side toward the compression cut.
- Use a non-metallic wedge to prevent the compression cut jamming on the blade.

- Chainsaws are designed to feed themselves into the wood and require only light pressure to cut efficiently. If extra force is required to keep cutting, the chain requires sharpening. Additional signs of a dull chain include a saw that is cutting crookedly, results in fine sawdust instead of chips, or generates a smell of burnt wood. Do not use a dull chain.
- Keep bystanders and helpers at a safe distance from operation.
- Do not operate a chainsaw when fatigued and take frequent breaks.
- Work slowly and don't rush.
- Make sure a fire extinguisher is present at all times when operating the chainsaw in forest or brushy areas.

9.2.4 Refueling the Engine

The fuel for gasoline-powered chainsaws shall be mixed in accordance with the manufacturer's recommendations as outlined in the chainsaw operator's manual. Fuel shall be stored and transported in an approved safety container. The following precautions should also be followed:

- The engine shall be shut off and allowed to cool before refueling; never refuel a hot engine.
- A fire extinguisher shall be present during fueling and refueling.
- Smoking around fueling or refueling operations shall be prohibited.
- A funnel or a flexible nozzle shall be used to avoid spilling fuel on the engine.

9.3 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 operations. Ensure the requirements in the referenced SOP are followed.

- Do not operate the drill rig in inclement weather.
- Verify that the rig is properly leveled and stabilized before raising the mast.
- Make sure that personnel are cleared from the sides and rear of the rig before the mast is raised.
- Do not to drive the rig with the mast in the raised position.
- Check for overhead power lines before raising the mast. Maintain a minimum distance of 10 feet (3 meters) between mast and overhead lines (<50 kV) and an additional 0.4 inch for every 1 kV over 50kV. Verify the voltage of nearby overhead power lines to calculate the minimum distance.
- Follow the requirements of the *Explosives Usage and Munitions Response (MR),* SOP HSE-610, if the project site is suspected to contain MEC contamination. MECs include UXO, discarded military munitions, materials that present a potential explosive hazard, CWM, MC, and contaminated soil or groundwater. "Down-hole" avoidance support may be required to prevent accidental contact with UXO. Safety requirements will be based on the risk assessment identified within the MR (safety) Opportunity Risk Evaluation.
- Stand clear before rig startup.
- 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.
- Equip the drill rig equipped with a kill wire or switch, and inform other personnel of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.

- Verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- Verify that all machine guards are in place while the rig is in operation.
- Maintain a clean work area.
- Equip the drill rip 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.

9.4 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 before moving.
- Ensure that drums and tanks remain covered except when removing or adding material or waste. Secure covers and/or lids properly 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 that can be either loaded manually or equipped with a bucket sling, a rough terrain forklift, roller conveyor equipped with solid rollers, or drum carts designed specifically for drum handling.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads and that it 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.
- Make sure that equipment cabs are supplied with fire extinguishers; they 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.
- Before handling, warm all personnel about hazards of handling.
- Before moving anything, consider the most appropriate sequence in which the various drums, portable tanks, and other containers should be moved. For example, small containers may have to be removed first to permit heavy equipment to enter and move the drums.
- Keep overpack drums and an adequate volume of absorbent near areas where minor spills may occur.
- Use containers or overpacks that are compatible with the waste or materials.
- Provide drums containing liquids or hazardous waste with secondary containment and do not locate them near a stormwater inlet or conveyance.
- Allow enough aisle space between drum pallets and between drums and other equipment to allow the drums to be easily accessed (at least 2 to 3 feet) by fire control equipment and similar equipment.
- Make sure that a spill kit is available in drum or tank storage areas (or where liquids are transferred from one vessel to another).

9.5 Drum Sampling Safety

Personnel are permitted to handle and/or sample drums containing certain types of waste (drilling waste, IDW, 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.
- Take precautions to prevent contaminated media from contacting the floor or ground, such as having plastic under the sampling area, having 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.

9.6 Earthmoving Equipment

(Reference CH2M HILL, SOP HSE-306, *Earthmoving Equipment*)

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

- CH2M HILL authorizes only those employees qualified by training or previous experience to operate material handling equipment.
- CH2M HILL employees must be evaluated before operating earthmoving equipment by a person designated by CH2M HILL. This evaluation will be documented according to SOP HSE-306, *Earthmoving Equipment*.
- Equipment must be checked at the beginning of each shift to ensure it is in safe operating condition and free of apparent damage. Items to be checked should include: service brakes, parking brakes, emergency brakes, tires, horn, backup alarm, steering mechanism, coupling devices, seat belts, and operating controls. All defects shall be corrected before the equipment is placed in service. Documentation of this inspection must be maintained onsite at all times (use the Earthmoving Equipment Inspection form if operated by CH2M HILL).
- Equipment must be on a stable foundation such as solid ground or cribbing; outriggers are to be fully extended.
- Equipment must not be used to lift personnel; loads must not be lifted over the heads of personnel.
- Equipment, or parts thereof, that are suspended must be substantially blocked or cribbed to prevent shifting before personnel are permitted to work under or between them. All controls shall be in a neutral position, with the motors stopped and brakes set.
- Equipment which is operating in reverse must have a reverse signal alarm distinguishable from the surrounding noise or a signal person when the operator’s view is obstructed.

- When equipment is used near energized power lines, the closest part of the equipment must be at least 10 feet (3 meters) from the power lines of less than 50kV. Provide an additional 4 feet (1.2 meters) for every 10 kV over 50 kV. A person must be designated to observe clearances and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance visually. Every overhead power line must be considered to be energized until the electrical utility authorities indicate that it is not an energized line and it has been visibly grounded.
- Underground utility lines must be located before excavation begins; refer to the Underground Utilities section of this HSP.
- Operators loading and unloading vehicles are responsible for seeing that vehicle drivers are in the vehicle cab or in a safe area.
- The parking brake shall be set whenever equipment is parked; wheels must be chocked when parked on inclines.
- When not in operation, the blade or bucket must be blocked or grounded, and the master clutch must be disengaged when the operator leaves the cab. When equipment is unattended, power must be shut off, brakes set, blades or buckets landed, and shift lever in neutral.

9.7 Excavation Activities

(Reference CH2M HILL SOP HSE-307, *Excavation and Trenching Safety*)

The requirements in this section shall be followed whenever excavation is being performed. Refer to the Earthmoving Equipment section and SOP for additional requirements applicable to operating/oversight of earthmoving equipment. Below are the hazard controls and safe work practices to follow when working around or performing excavation. Ensure the requirements in the referenced SOP are followed.

- If the project site is suspected of MEC contamination, the requirements of the *Explosives Usage and Munitions Response (MR),* SOP HSE-610, shall be followed. MECs include UXO, discarded military munitions, MPPEH, CWM, MC, and contaminated soil or groundwater. Downhole avoidance support may be required to prevent accidental contact with UXO. Safety requirements will be based on the risk assessment identified within the MR (safety) Opportunity Risk Evaluation.
- Do not enter the excavations unless completely necessary, and only after the competent person has completed the daily inspection and has authorized entry. An inspection shall be conducted by the competent person before work begins, as needed throughout the shift, after every rainstorm, and after any hazard-increasing occurrence. Documentation of the inspection must be maintained onsite at all times.
- Follow all excavation entry requirements established by the competent person and any excavation permit being used.
- 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 deep (1.5 meters) and there is no indication of possible cave-in, as determined by the competent person. Protective systems for excavations deeper than 20 feet (6.1 meters) must be designed or approved by a registered professional engineer.
- Trenches more 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).
- The atmosphere of excavations more than 4 feet (1.2 meters) deep shall be tested before entry when a hazardous atmosphere exists or could reasonably be expected to exist, such as excavations in landfills, hazardous waste dumps, areas containing sewer or gas utility systems or petroleum distillates, or areas where hazardous substances are stored nearby.
- 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.
- Excavations shall not be entered when:
  - Protective systems are damaged or unstable.

- Objects or structures above the work location may become unstable and fall into the excavation.
- The potential for a hazardous atmosphere exists, unless the air has been tested and found to be at safe levels.
- Water has accumulated in the excavation, unless precautions have been taken to prevent excavation cave-in.

- The excavation self-assessment checklist shall be used to evaluate excavations before entry.

Excavation Operations

Refer to the Excavation Entry section when entering excavations controlled by other parties. When CH2M HILL performs the excavating, a CH2M HILL-designated competent person will oversee all excavation operations and entry into excavations. The competent person shall:

- Complete the CH2M HILL Excavation Permit (attached to this HSP) to ensure HSE requirements have been satisfied during excavation activities.
- Complete the CH2M HILL Daily Excavation Inspection Checklist (attached to this HSP) to ensure HSE requirements have been satisfied, document that an inspection has been conducted, and to authorize entry into the excavation. A new checklist shall be completed each day, authorizing excavation entry. Inspections should be continued as needed throughout the work shift, and after any event that could increase the potential for cave-in (for example, rainfall).
- Conduct daily safety briefings before excavation entry.

9.8 Fall Protection Activities

(Reference CH2M HILL, SOP HSE-308, *Fall Protection*)

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are exposed to unprotected heights. Ensure the requirements in the referenced SOP are followed.

- Fall protection systems must be used to eliminate fall hazards when performing construction activities at a height of 6 feet (1.8 meters) or greater and when performing general industry activities at a height of 4 feet (1.2 meters) or greater.
- CH2M HILL personnel exposed to fall hazards must complete initial fall protection training by completing either the CH2M HILL 10-hour construction safety awareness training course or the fall protection computer-based training module. Personnel must also receive project-specific fall protection training using the fall protection evaluation form attached to this HSP. Personnel shall not use fall protection systems for which they have not been trained.
- The SC or designee must complete the Project Fall Protection Evaluation Form and provide project-specific fall protection training to all CH2M HILL staff members exposed to fall hazards.
- The company responsible for the fall protection system shall provide a competent person to inspect and oversee the use of fall protection system. CH2M HILL staff members shall be aware of and follow all requirements established by the competent person for the use and limitation of the fall protection system.
- When CH2M HILL designs or installs fall protection systems, the staff shall be qualified as persons or work directly under the supervision of a CH2M HILL-designated competent person.
- When horizontal lifelines are used, the company responsible for the lifeline system shall provide a fall protection-qualified person to oversee the design, installation, and use of the horizontal lifeline.
- Inspect personal fall arrest system components before each use. Do not use damaged fall protection system components at any time, or for any reason. Fall protection equipment and components shall be used only to protect against falls, not to hoist materials. Personal fall arrest systems that have been subjected to impact loading shall not be used. The SC shall periodically inspect CH2M HILL fall protection equipment using the Fall Protection Inspection Log form.

- Personal fall arrest systems shall be configured so that individuals can neither free-fall more than 6 feet (1.8 meters) or contact any lower level.
- Only attach personal fall arrest systems to anchorage points capable of supporting at least 5,000 pounds (2268 kilograms). Do not attach personal fall arrest systems to guardrail systems or hoists.
- Remain within the guardrail system when one is provided. Leaning over or stepping across a guardrail system is not permitted. Do not stand on objects (boxes, buckets, bricks, blocks, etc.) or ladders to increase working height on top of platforms protected by guardrails.
- Only one person shall be simultaneously attached to a vertical lifeline and a separate independent lifeline.

9.9 Forklift Operations

(Reference CH2M HILL, SOP HSE-309, *Forklifts*)

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

- A rated lifting capacity must be posted in a location readily visible to the operator.
- A forklift truck must not be used to elevate employees unless a platform with guardrails, a back guard, and a kill switch is provided on the vehicle. When guardrails are not possible, fall arrest protection is required.
- The subcontractor operating the forklift must post and enforce a set of operating rules for forklift trucks.
- Only certified forklift operators shall operate forklifts.
- Stunt driving and horseplay are prohibited.
- Employees must not ride on the forks.
- Employees must never be permitted under the forks (unless forks are blocked).
- The driver must inspect the forklift once a shift and document this inspection.
- The operator must look in the direction of travel and must not move the vehicle until all persons are clear of the vehicle.
- Forks must be carried as low as possible.
- The operator must lower the forks, shut off the engine, and set the brakes (or block the wheels) before leaving the forklift operator's position unless maintenance or safety inspections require the forklift to be running.
- Trucks must be blocked and have brakes set when forklifts are driven onto their beds.
- Extreme care must be taken when tilting elevated loads.
- Every forklift must have operable brakes capable of safely stopping it when fully loaded.
- Forklifts must have parking brakes and an operable horn.
- When the operator is exposed to possible falling objects, industrial trucks must be equipped with overhead protection (canopy).
- If certified CH2M HILL forklift operators are being used, forklifts must be inspected and documented daily using the forklift inspection form.

9.10 Groundwater Sampling/Water Level Measurements

Below are the hazard controls and safe work practices to follow when 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 are not 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 the headspace of wells before 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 onsite and during sampling.
- Use ear plugs during sampling if sampling involves a generator.
- Storeall purge water in containers and transport it 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.

9.11 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 using hand and power tools. Ensure the requirements in the referenced SOP are followed:

- Inspect tools before use, and tag and remove damaged tools from service.
- Use or operate hand tools for their intended use and 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.
- Plug portable power tools into GFCI-protected outlets.
- Ensure that portable power tools are Underwriters Laboratories-listed and have a three-wire grounded plug or are 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).
- Ensure that safety guards on tools remain installed while the tool is in use and are 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.
- Confirm that if a cordless tool is connected to its recharge unit, both pieces of equipment conform strictly with electrical standards and manufacturer's specifications.

- Confirm that tools used in an explosive environment are 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.
- Unplug jammed equipment only when equipment has been shut down; all sources of energy have been isolated; and equipment has been locked/tagged and tested.
- Ensure that equipment to undergo maintenance and repair that results in the removal of guards or would otherwise put anyone at risk is locked out before beginning work.

9.12 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.
- Site UXO-14 has documented high levels of Lead contaminated surface soils. The tasks being performed in this area are not anticipated to generate elevated dust levels and therefore they will not generate airborne Lead concentrations above the Action Level. The project team will have Lead Exposure training and will be performing real time dust monitoring to ensure that the total dust levels do not exceed the total dust action level of 0.5 mg/m3. Through exposure modeling performed to evaluate the potential for Lead exposure to personnel performing these sampling tasks, if total dust levels are maintained below the action level, then airborne Lead exposure is not anticipated. If dust levels start to increase the sampling team will have the ability to implement dust control measures such as spraying the walking working surface with water to keep the dust levels below the action level. Dermal exposure will also be controlled through this same method. The sampling team will also use PPE to control dermal exposures that may be encountered due to the sampling process.
- The Lead Competent Person shall be the CH2M HILL SC. This person is required to identify existing and potential lead hazards in the work environment and take prompt corrective action to eliminate or control such hazards. The designated “competent person” must be, at a minimum, able to perform the following if airborne concentrations of Lead are expected to be greater than 30 $\mu g/m^3$:
- Establish regulated areas if needed and ensure that access to and from those areas is limited to authorized employees.
- Ensure the adequacy of any employee exposure monitoring.
- Ensure that all employees exposed to airborne lead levels above the PEL wear the appropriate personal protective equipment and are trained to use appropriate methods to control lead exposure.
- Ensure that proper hygiene facilities are provided and that workers are trained to use these facilities.
- Ensure that required engineering controls are implemented, maintained in proper operating condition, and functioning properly.

9.12.1 Exposure Monitoring

- When airborne concentrations of lead are anticipated during work activities such as remediation, construction or demolition, an initial exposure assessment shall be conducted to determine employees’ exposure to lead. Where objective data is available (within the last 12 months using the same methods/materials) that demonstrates that employee exposures to lead will not exceed airborne concentrations at or above the AL under expected site conditions, initial monitoring is not required.

- Initial exposure monitoring is conducted to document employees' breathing-zone exposures over the course of a full shift. A representative 8-hour TWA sample shall be collected for each job classification in each work area.
- When initial monitoring results are below the AL, monitoring may be suspended.
- Additional monitoring is required when there has been a change in production process, control equipment, personnel, or work practices that may result in new or additional exposures.
- Employees shall be informed in writing of exposure monitoring results within 5 working days after receipt of the results.
- Air sampling will also be performed outside the regulated area to verify that lead is not being generated outside the regulated area. One sample shall originate upwind from the work and one downwind from the work.

9.12.2 Respiratory Protection

- Respiratory protection must be used during the following: periods when employee exposure to lead exceeds the PEL; work operations for which engineering and work-practice controls are not sufficient to reduce employee exposure to or below the PEL; periods when an employee requests a respirator; and periods when respirators are required to provide interim protection during initial exposure assessments.
- Respiratory protection selection shall be based on the most relevant exposure monitoring results.
- A respiratory protection program, including respirator selection, shall be implemented in accordance to OSHA 29 CFR 1910.134 and with CH2M HILL SOP HSE-121, Respiratory Protection. Subcontractor respiratory protection programs shall meet or exceed these requirements.
- When air-purifying respirators are utilized, the HEPA filters shall be replaced at the beginning of each shift.
- Powered air-purifying respirators (PAPR) shall be provided to employees who request such a respirator and where it will provide adequate protection.
- If an exposure assessment for this type of removal is not available, the assumption is that this is an abrasive blasting operation. It will be assumed that concentrations of airborne lead will be in excess of 2,500 ug/m^3 and supplied air respiratory protection will be required within the regulated area.
- TABLE FROM 29 CFR 1926.62 - RESPIRATORY PROTECTION FOR LEAD AEROSOLS

• Airborne concentration of lead or condition of use	• Required respirator[1]
• Not in excess of 500 ug/m^3	• - 1/2 mask air purifying respirator with high efficiency filters[2,3]. - 1/2 mask supplied air respirator operated in demand (negative pressure) mode.
• Not in excess of 1,250 ug/m^3	• Loose fitting hood or helmet powered air purifying respirator with high efficiency filters[3]. - Hood or helmet supplied air respirator operated in a continuous-flow mode - e.g., type CE abrasive blasting respirators operated in a continuous-flow mode.
• Not in excess of 2,500 ug/m^3	• Full facepiece air purifying respirator with high efficiency filters[3]. - Tight fitting powered air purifying respirator with high efficiency filters[3]. - Full facepiece supplied air respirator operated in demand mode. - 1/2 mask or full facepiece supplied air respirator operated in a continuous-flow mode.

• Airborne concentration of lead or condition of use	• Required respirator[1]
	- Full facepiece self-contained breathing apparatus (SCBA) operated in demand mode.
• Not in excess of 50,000 ug/m^3	• 1/2 mask supplied air respirator operated in pressure demand or other positive-pressure mode.
• Not in excess of 100,000 ug/m^3	• - Full facepiece supplied air respirator operated in pressure demand or other positive-pressure mode - e.g., type CE abrasive blasting respirators operated in a positive-pressure mode.
• Greater than 100,000 ug/m^3 unknown concentration, or fire fighting	• Full facepiece SCBA operated in pressure demand or other positive-pressure mode.

- [1]Respirators specified for higher concentrations can be used at lower concentrations of lead.
- [2]Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.
- [3]A high efficiency particulate filter (HEPA) means a filter that is a 99.97 percent efficient against particles of 0.3 micron size or larger.

9.12.3 PPE

- Personnel shall wear disposable coveralls, booties and inner and outer gloves when inside the regulated area and exercise enhanced personal hygiene (for example, frequent hand washing prior to eating, drinking, and smoking; separation of work and street clothing and footwear; etc.).
- Contact lenses should not be worn when working with lead.
- Employee shall not be allowed to leave the regulated area wearing any protective clothing or equipment that is required during the work shift.
- All clothing requiring laundering will be packaged in a sealed container. Containers shall be labeled as follows: “Caution: Clothing contaminated with lead; do not remove dust by blowing or shaking. Dispose of lead-contaminated wash water in accordance with applicable local, state, or federal regulations.”

9.12.4 Written Lead Compliance Program

- When employee exposures are greater than the PEL, a written lead compliance program shall be established and implemented prior to commencement of operations. The written program shall outline the plans for maintaining employee exposure below the PEL. The compliance program shall be based on the most recent exposure monitoring data. The program shall be revised when exposure monitoring data is updated or at least annually to reflect the status of the program.

9.12.5 Regulated Areas

- Regulated areas shall be documented as part of the written lead compliance program.
- Regulated areas are those where airborne concentrations of lead are above the PEL without regard to the use of respirators. Personnel shall not enter regulated areas unless training, medical monitoring, and PPE, including respirator protection, requirements have been met.
- Regulated areas shall be demarcated and entry to these areas shall be limited. Only authorized personnel are allowed in these areas.
- The entrance to regulated areas shall be posted with signs that read “WARNING-LEAD WORK AREA-POISON-NO SMOKING OR EATING” so that necessary protective steps can be taken before entering regulated areas.
- Where feasible, shower facilities shall be installed and employees who work in regulated areas shall be required to shower at the end of the work shift. These facilities must be provided with an adequate supply of cleaning agents and towels.

- Hand washing facilities shall be provided for employees working in regulated areas. Furthermore, employees shall be required to wash their hands and face at the end of each work shift and prior to eating or entering eating facilities, drinking, smoking, or applying cosmetics.
- Employees shall not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in any areas where exposure to lead is above the PEL (that is, regulated areas).
- In addition to the posting requirements, written or verbal notification to owners, contractors, and other personnel working in the area shall be made.

9.12.6 Housekeeping

- Where airborne lead concentrations exceed the PEL, housekeeping procedures shall be documented in the written lead compliance program.
- All surfaces shall be maintained as free as possible of accumulations of lead. Methods selected for cleaning of surfaces and floors shall be those that minimize the likelihood of lead becoming airborne (for example, vacuuming).
- Where vacuuming methods are selected, the vacuums shall be used and emptied in a manner that minimizes the reentry of lead into the workplace.
- Compressed air shall not be used to remove lead from any surface unless used in conjunction with a ventilation system designed to capture the airborne dust created by the compressed air.
- Waste containing significant amounts of lead may be subject to hazardous waste regulations and the corresponding generation, treatment and disposal requirements.

9.12.7 Medical Monitoring

- CH2M HILL shall make available initial medical surveillance (baseline) to employees occupationally exposed on any day to lead at or above the AL. Initial medical surveillance consists of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin (ZPP) levels.

9.12.8 Training

- CH2M HILL employees must complete the on-line Lead Exposure Module located on the HSSE web page of the virtual office and project-specific lead-exposure-control training.
- Project-specific lead-exposure-control training shall include the following:
- Discussion of site-specific lead hazards and associated control measures,
- Information contained in the Lead Fact Sheet.
- Quantity, location, manner of use, storage, sources of exposure, and the specific nature of operations that could result in exposure to lead, as well as any necessary protective steps,
- Purpose, proper use, and limitation of respirators,
- Purpose and a description of the medical surveillance program,
- Engineering controls and work practices associated with the employee's job assignment.
- See SOP-508, Lead, for further requirements.

9.13 LO/TO Activities

(Reference CH2M HILL SOP HSE-310, *Lockout and Tagout*)

LO/TO shall be performed whenever service or maintenance is necessary on equipment that could cause injury to personnel from the unexpected equipment energizing or startup or unexpected release of stored energy. Energy sources requiring LO/TO may include electrical, pneumatic, kinetic, or potential sources.

If work on energized electrical systems is necessary—contact the RHSM. Specific training and procedures are required to be followed before any work on energized electrical systems can be performed and are NOT covered in this section. Energized electrical work is defined as work performed **on or near** energized electrical systems or equipment with exposed components operating at 50 volts or greater. Working near energized live parts is any activity inside a limited approach boundary (anywhere from 3.5 feet to 24 feet [1 meter 7.3 meters] depending on voltage). Examples of energized electrical work include using a voltmeter to troubleshoot electrical systems and changing out controllers.

When LO/TO is necessary to perform maintenance/repair of a system, all the requirements of SOP HSE-310, *Lockout and Tagout*, shall be met, including the following items:

- When CH2M HILL controls the work, CH2M HILL must verify that subcontractors affected by the unexpected operation of equipment develop a written LO/TO program, provide training on LO/TO procedures, and coordinate its program with other affected subcontractors. This may include compliance with the owner or facility LO/TO program.
- When CH2M HILL personnel will be affected by the unexpected operation of equipment, they must complete the electrical safety awareness module on the VO. Authorized personnel shall inform the affected personnel of the LO/TO. Affected personnel shall not tamper with LO/TO devices.
- Standard LO/TO procedures include the following steps: 1) notify all personnel in the affected area of the LO/TO, 2) shut down the equipment using normal operating controls, 3) isolate all energy sources, 4) apply individual lock and tag to each energy isolating device, 5) relieve or restrain all potentially hazardous stored or residual energy, and 6) verify that isolation and de-energizing of the equipment has been accomplished. Once it is verified that the equipment is at the zero energy state, work may begin.
- All safeguards must be put back in place, all affected personnel notified that lockout has been removed; and controls positioned in the safe mode before lockout removal. Only the individual who applied the lock and tag may remove them.
- CH2M HILL authorized employees shall complete the LO/TO training module on the VO and either the electrical safety training module on the VO or 10-hour construction training. The authorized employees must also be trained and qualified on the system they are working on (for example, qualified electricians working on electrical components of a system).
- When equipment-specific LO/TO procedures are not available or when existing procedures are insufficient, CH2M HILL authorized employees shall also complete the equipment-specific LO/TO procedure development form, provided as an attachment to this HSP, to create an equipment-specific LO/TO procedure.

9.14 Avoidance of MEC and/or MPPEH

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

If work will be conducted on a government/military facility or ex-government/military facility; area currently or previously used as a range; or if military munitions, MEC, or UXO are associated with the scope of work or location, immediately contact the CH2MHILL central point of contact for explosives usage and MR. The following will be required before any field work:

- Setting up a conference call with all required personnel to conduct a basic safety risk assessment over the phone.
- Providing written directions detailing job-specific requirements and what actions to take to ensure safety during the work.
- 3R Training (Recognize, Retreat, and Report) will be required for all affected project personnel.

9.14.1 MEC

At Site UXO-01 (ASR#2.23), munitions used while the range was active included fragmentation, offensive, and practice grenades.

Site UXO-01 (ASR#2.79a, b, c) partially overlaps with the Former Miniature Anti-tank Range (Site UXO-05) where .22 caliber small arms ammunition was fired at a moving target car located on a transverse track. The Former B-3 Gas Chamber (UXO-01, ASR#2.79a,b, and c), was operated between 1953 and 1958 (USACE, 2001), and involved the use of chemical warfare training agents, such as tear gas. There is no evidence that CWM would have been used during training activities; however, the area surrounding gas chambers was often used for other chemical training. Therefore, it has been suggested that chemical agent identification sets and riot control hand grenades may have been used at the Former B-3 Gas Chamber (USACE, 2001). No evidence has been found to confirm this.

For Site UXO-02,USACE concluded that 60mm and 81mm mortars (practice, high explosive white phosphorus, illumination) may have been fired on the area known as Mortar Range "L-2" (USACE, 2001). However, a former Range Control Officer stated that Mortar Range "L-2" was used a platoon/squad maneuver range with mortar projectiles used for illumination. As such, 60mm and 81mm illumination mortars and 40mm practice grenades would have been used on Mortar Range "L-2". The firing position for Mortar Range "L-2" was along the southern boundary of UXO-02, with impact trajectories due north into the New River.

At Site UXO-07, MEC expected to be encountered includes fuses and practice hand grenades. The southern area of Site UXO-07 may have overlapped the Former 5th Area Gun Park. This gun park was a large parking area with concrete pads and small sheds where 105mm and 155mm howitzers of the 10th Marines (Artillery Regiment) were stored along with the trucks that pulled the howitzers.

At Site UXO-11, the location of the former B-5 Practice Hand Grenade Course, only practice hand grenades and fuzes are expected.

At Site UXO-14, only small arms ammunition was used at the former Indoor Pistol Range. It is assumed that tear gas was used at the former Gas Chamber. No evidence of CWM has been found onsite.

At UXO-17, the location of former Firing Position 2, there should be no unexploded ordnance (UXO) present, based on the activities conducted at the site. A former MCB Camp Lejeune Range Control Officer indicated that the following ordnance may have also been used at the site: 4.2-inch mortar, 175 mm gun, 8-inch howitzer, and 120 mm mortar.

At Site UXO-21, only chemical warfare training agents (tear gas) would have been used for gas mask confidence drills. However, other chemical training, including chemical agent identification sets and riot control hand grenades, may have been used in the area surrounding the gas chamber. No evidence of CWM has been found onsite.

Explosives Safety Submissions (ESSs) that cover intrusive activities at Site UXO-01 (ASR#2.23), UXO-02, UXO-07, and UXO-11 have been approved by the Marine Corps System Command under base-wide Explosives Safety Submission (ESS). Amendment 2 to the ESS for Site UXO-17 (ESS-117) that includes intrusive activities for the 16-acre site was approved by MARCORSYSCOM on 10 March 2011. The ESS for Site UXO-21 that covers intrusive activities was approved by the Department of Defense Explosives Safety Board (DDESB) on September 16, 2009. ESS determinations for Site UXO-01 (ASR#2.79a, b, and c) and Site UXO-14 will be submitted for intrusive operations at the subject sites. Intrusive investigation activities at Site UXO-01 (ASR #2.79a, b, and c) and Site UXO-14 will not be conducted until the ESS determination from the Marine Corps System Command is received.

All work will follow the approved WP, which is based on the DDESB-approved ESSs.

9.14.2 Munitions with the Greatest Fragmentation Distance

The primary and contingency munitions with the greatest fragmentation distance (MGFDs) used to calculate safe working distances at sites with explosive risks is summarized in Table 4-1 of the WP. Sites UXO-01 (ASR#2.79a, b, and c) and UXO-14 only have histories of small arms ammunition use, and therefore have no ESSs. MGFDs do not apply at Sites UXO-01 (ASR#2.79a, b, and c) and UXO-14.

The explosives safety quantity-distance (ESQD) information for the MGFD is provided in Chapter 3 of each ESS for the applicable sites. During the course of this project, if MEC with a greater fragmentation range is encountered at any site, the ESQD requirements will be adjusted. In the unlikely case that a MEC item with a greater fragmentation range than the contingency MGFD is encountered, the ESQD arcs will be adjusted and the site ESS will be amended. Work must stop until the amended ESS is approved.

9.14.3 MEC Hazard Mitigation

According to Mr. James Gagnon of the Natural Resources Conservation Service, Edenton Technical Services Office, frost upheaval in the coastal plain region of North Carolina is considered unlikely because the climate only allows frost action to occur to a maximum depth of approximately 6 inches. No other natural phenomena (for example, drought, flooding, erosion, tidal changes) exist for this area. Therefore, migration of MEC (other than through human transport) is not considered likely.

9.14.4 Types of Explosives to be used on Site

No explosives are anticipated to be stored or used on the project site. During the course of this project, if MEC is encountered it will be disposed of in accordance with the DDESB-approved ESS for the respective site. If an approved ESS is not in place and MEC is identified, Base Explosive Ordnance Disposal personnel will be contacted for disposal of the item.

9.14.5 Explosives Storage, Transportation and Management

No explosives are anticipated to be stored or used on the project site. If MEC is encountered, explosives storage, transportation, and management will be conducted in compliance with the Explosives Siting Plan, the DDESB-approved ESS, and the Explosives Management Plan for the project.

9.14.6 MEC Avoidance Procedures

MEC avoidance operations will be required for select tasks associated with the expanded Site Investigation. Avoidance operations will consist of a team composed of one or more UXO Technicians. **Contact with MEC is prohibited during avoidance activities.** The UXO Team will initiate disposal operations for any MEC/MPPEH encountered. All additional MEC avoidance procedures are described below.

Access routes to sampling locations. Before sampling, the UXO Technician will conduct a reconnaissance of the sampling area. The reconnaissance will include locating the designated sampling or drilling location(s) and making sure they are free of surface MEC. If surface MEC is detected, the point will be relocated as directed. Once the designated point has been cleared, an access route for the sampling crew's vehicles and equipment will be cleared for surface MEC. The access route will be at least twice the width of the widest vehicle, and the boundaries will be clearly marked to prevent personnel from straying into non-cleared areas. If surface MEC is encountered, the UXO Team will mark and report the item and divert the approach path around the MEC.

Soil Sampling and Monitoring Well Locations. The UXO Technicians will clear the surface area of the work site for soil sampling and monitoring well installation. The area will be clearly marked and large enough to accommodate the direct push equipment and provide a work area for the crews. As a minimum, the cleared area will be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment for use onsite. If a pre-selected area indicates magnetic anomalies, a new sampling / drill site will be chosen.

Subsurface Soil Sampling. If surface samples are required, they will be obtained before the start of hand augering. The subsurface soil sampling will be completed using a hand auger. Before sampling, the sampler will advance a borehole using a hand auger, with the UXO Technician checking the borehole with a downhole magnetometer a minimum of every 1 foot in depth, to the deepest sampling depth or a maximum of 5 feet to ensure that smaller items of MEC undetectable from the surface will be detected. If any MEC item is identified during sampling, work will stop and the depth of downhole sampling will be re-evaluated.

9.15 Portable Generator Hazards

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

- Portable generators are useful when temporary or remote electric power is needed, but they also can be hazardous. The primary hazards to avoid when using a generator are carbon monoxide (CO) poisoning from the toxic engine exhaust, electric shock or electrocution, and fire.
- NEVER use a generator indoors or in similar enclosed or partially enclosed spaces. Generators can produce high levels of CO very quickly. When you use a portable generator, remember that you cannot smell or see CO. Even if you can’t smell exhaust fumes, you may still be exposed to CO.
- If you start to feel sick, dizzy, or weak while using a generator, get to fresh air RIGHT AWAY. DO NOT DELAY. The CO from generators can rapidly lead to full incapacitation and death.
- If you experience serious symptoms, get medical attention immediately. Inform project personnel that CO poisoning is suspected. If you experienced symptoms while indoors, have someone call the fire department to determine when it is safe to re-enter the building.
- Follow the instructions that come with your generator. Locate the unit outdoors and away from doors, windows, and vents that could allow CO to come indoors.
- Ensure that the generator is grounded in accordance with the manufacturer’s operation manual.
- Keep the generator dry and do not use in rain or wet conditions. To protect the generator from moisture, operate it on a dry surface under an open, canopy-like structure. Dry wet hands before touching the generator.
- Plug appliances directly into the generator. Or, use a heavy duty, outdoor-rated extension cord that is rated (in watts or amps) at least equal to the sum of the connected appliance loads. Check that the entire cord is free of cuts or tears and that the plug has all three prongs, especially a grounding pin.
- Most generators come with GFCIs. Test the GFCIs daily to make sure they are working
- If the generator is not equipped with GFCI-protected circuits, plug a portable GFCI into the generator and plug appliances, tools, and lights into the portable GFCI.
- Never store fuel near the generator or near any sources of ignition.
- Before refueling the generator, turn it off and let it cool down. Gasoline spilled on hot engine parts could ignite.

9.16 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 the 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 use 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.
- The wand must not be modified.
- 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, when operating pressure-washing equipment.

9.17 Rigging

(Reference CH2M HILL SOP HSE-316, *Rigging*)

Below are the hazard controls and safe work practices to follow when personnel are overseeing or performing rigging. Ensure the requirements in the referenced SOP are followed.

9.17.1 General

- All rigging equipment shall be used only for its intended purpose, inspected by a competent person before use, and shall not be loaded in excess of its capacity rating. Defective rigging shall be removed from service.
- When CH2M HILL is in control of rigging operations, CH2M HILL shall provide a rigging- competent person who will inspect, maintain, and oversee all rigging operations. The competent person shall use the appropriate rigging inspection log form to inspect wire rope, synthetic slings, and/or shackles.
- Tag lines shall be attached to every load being lifted by a crane.
- Rigging equipment shall be protected from flame cutting and electric welding operations, and contact shall be avoided with solvents and chemicals.
- Rigging equipment, when not in use, shall be stored in an area free from damage caused by environmental elements, hazardous substances, and other factors that may compromise equipment integrity and performance.
- No modification or addition that could affect the capacity and or safe operation of the equipment shall be made without the manufacturer’s written approval.
- Rigging equipment shall not be shortened with knots, bolts or other makeshift devices.
- All rigging equipment shall be load-tested at least annually by a competent person and documented.
- Special hoisting devices, slings, chokers, hooks, clamps, or other lifting accessories shall be marked to indicate the safe working loads and shall be proof -tested before initial use to 125 percent of their rated load. Vendors or suppliers will provide documentation of proof testing documentation.

9.17.2 Equipment

- Protruding end strands of wire rope shall be covered or blunted.
- Wire rope shall not be used, if in any length or diameter, the number of visible broken wires exceeds 10 percent of the total number of wires, or if the rope shows other signs of excessive wear, corrosion, or defect.
- When inspecting the end fittings of wire rope slings, if more than one wire in a lay is broken in the fitting, do not use the sling.

- Synthetic web slings shall be immediately removed from service if any of the following conditions are present:
  - acid or caustic burns, melting or charring of any part of the sling
  - surface snags, punctures, tears or cuts; broken or worn stitches; distortion of fittings
  - discoloration or rotting red warning line visible
- Makeshift hooks, links, or other fasteners shall never be used. Job or shop hooks and links, or makeshift fasteners, formed from bolts, rods, etc., or other such attachments, shall not be used.
- Alloy steel chains shall have permanently affixed identification stating size, grade, rated capacity and reach.
- Shackles and hooks shall be constructed of forged alloy steel with the identifiable load rating on the shackle or hook.

9.17.3 Rigging Use

- Do not pull rigging from under a load when the load is resting on the rigging.
- Place sling(s) in center bowl of hook.
- When attaching slings to the load hoist hook, “pack” corners and sharp edges to prevent cutting or damaging the rope or slings.
- Never use nylon, polyester, or polypropylene web slings. Do not use web slings with aluminum fittings where fumes, vapors, sprays, mists or liquids of acids, caustics, or phenolics are present.
- Use natural and synthetic fiber rope slings, except for wet frozen slings, in a temperature range from from minus 20º F to plus 180º F without decreasing the working load limit. For operations outside this temperature range, and for wet frozen slings, follow the sling manufacturer’s recommendations.
- When used for eye splices, install the U-bolt so that the “U” section is in contact with the dead end of the rope.

9.18 Stairways and Ladders

(Reference CH2M HILL SOP HSE-214*, Stairways and Ladders*)

Below are the hazard controls and safe work practices to follow when using stairways and ladders. Ensure the requirements in the referenced SOP are followed.

- A stairway or ladder is generally required when a break in elevation of 19 inches (48.3 centimeters) or more exists.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected by a competent person for visible defects before each day’s use. Defective ladders must be tagged and removed from service.
- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- Ladder safety training on safe use (for example, review SOP HSE-214 as part of a safety meeting) must be documented and kept with the project files.
- Only one person at a time shall climb on or work from an individual ladder.
- User must face the ladder when climbing, keeping his or her belt buckle between the side rails.
- Ladders shall not be moved, shifted, or extended while in use.
- User must use both hands to climb and use rope to raise and lower equipment and materials.

- Straight and extension ladders must be tied off to prevent displacement.
- Ladders that may be displaced by work activities or traffic must be secured or barricaded.
- Portable ladders must extend at least 3 feet (91.5 centimeters) above landing surface.
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder.
- Stepladders are to be used in the fully opened and locked position.
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder.
- Fixed ladders $\geq$ 24 feet (7.3 meters) in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders more than six feet (1.8 meters) from lower levels, and both hands are needed to perform the work or when reaching or working outside of the plane of ladder side rails.

9.19 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 subcontractor. 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.
- Ensure that all personnel staff working adjacent to traveled way or within work area wear reflective/high-visibility safety vests.
- Wear eye protection 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 (breakdown lane), etc.
- Always remain aware of an escape route (for example, 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, use 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.
- Ensure that the work area is 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 depend on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.
- Position either a barrier or shadow vehicle a considerable distance ahead of the work area. The vehicle should be equipped with a flashing arrow sign and truck-mounted crash cushion. All vehicles within 40 feet (12.2 meters) of traffic should have an orange flashing hazard light atop the vehicle.

- Except on highways, use flaggers 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.
- Use lookouts when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers.
- Park vehicles 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.
- Complete the traffic control training module on the VO when CH2M HILL workers work in and around roadways and are exposed to public vehicular traffic.

9.20 Underground Utilities

An assessment 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 tasks.

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

1. Making 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. Conducting 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, 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 section 9.20.6).

Any deviation from these requirements must be approved by the RHSM and the PM.

9.20.1 Background and Records Assessment of Known Utilities

Identify any client- or location-specific permit and/or procedural requirements (for example, 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 because they are rarely 100 percent accurate.

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

9.20.2 Designated Local Utility Locating Service

Contact your designated local utility locating service (for example, Dig-Safe, Blue Stake, One Call) to identify and mark the location of utilities. Call 811 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.

9.20.3 Independent Field Survey (Utility Locate)

The organization conducting the intrusive work (CH2M HILL or subcontractor) shall arrange for 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 select the most appropriate instrumentation/ technique or combinations of instrumentation/techniques to identify subsurface utilities based on its 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, 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 the 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 begins 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.

9.20.4 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 beginning intrusive activities and take any actions needed to avoid striking the utility or obstruction.

9.20.5 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, manual digging, or manual 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).Find out whether the utility can be isolated during intrusive work.

9.20.6 Intrusive Activities within 2 feet of an Underground Utility

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

9.20.7 Spotter

A spotter shall monitor for signs of the presence of utilities during advancement of intrusive work (for example, 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 (for example, air horn, hand signals) to alert an operator to stop the intrusive activity.

9.21 Overhead Utilities

9.21.1 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 find out 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 obtaining this information.

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 clearances from energized overhead lines listed in the table below are observed, or the equipment is be repositioned and blocked to ensure that no part, including cables, can come within the minimum clearances shown in the table.

MINIMUM DISTANCES FROM POWER LINES	
Power lLines Nominal System kV	Minimum Required Distance, Feet (Meters)
0-50	10 (3.0)
50-200	15 (4.6)
201-350	20 (6.1)
351-500	25 (7.6)
501-750	35 (10.7)
751-1,000	45 (13.7)
Over 1,000	Established by utility owner/operator or by a professional engineer in electrical power transmission/distribution

(These distances eliminate the potential for arcing based on the line voltage.)

- The power line(s) has been isolated through the use of insulating blankets that have been properly placed by the utility. If insulating blankets are used, the utility will establish the minimum safe operating distance; get this information in writing, including 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 before the start of work.

9.22 Welding and Cutting

(Reference CH2M HILL, SOP-314, *Welding and Cutting*)

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

- Workers designated to operate welding and cutting equipment shall have been properly instructed and qualified to operate such equipment.
- Before welding or cutting is permitted, the area shall be inspected by the individual responsible for authorizing the welding or cutting operation. The authorization, preferably in the form of a written permit, shall detail precautions to be taken before work is to begin.
- Suitable fire extinguishing equipment shall be immediately available in the work area.
- Flame-resistant blankets shall be used to control sparks produced by welding and cutting operations from traveling to lower levels or adjacent surfaces.
- If the valve on a fuel-gas cylinder is found to leak around the valve stem, the valve shall be closed and the gland nut tightened. If this does not stop the leak, the cylinder is to be tagged and removed from service.
- Nothing should be placed on top of a cylinder or manifold that will damage it or interfere with the quick closing of the valve.
- Flow gages and regulators shall be inspected before use and removed from cylinders when not in use.
- Hoses, leads, and cables shall not be routed through doorways and walkways unless covered, elevated, or protected from damage. Where hoses, leads, and cables pass through wall openings, adequate protection shall be provided to prevent damage.
- Flash arresters shall be installed at the torch handle.
- Arc welding electrodes shall not be struck against compressed gas cylinders to strike an arc.
- All arc welding or cutting operations shall be shielded by noncombustible or flame-resistant screens to protect employees or other persons in the vicinity from the direct rays of the arc.
- Proper ventilation shall be provided to maintain the level of contaminants in the breathing zone of welders below applicable PELs.
- Minimum PPE includes the following:
  - Safety-toed shoes or boots, hard hats, and safety glasses
  - Body protection (such as gloves, coveralls, or Tyvek) when chemical hazards exist
  - Hearing protection when working close to loud equipment and machinery
  - Protective clothing and gloves to prevent burns
  - Suitable eye protective equipment for the type of welding or cutting performed
  - Opaque screens to block arc flash from arc welding and cutting operations
  - Mechanical ventilation systems for welding and cutting operations conducted in enclosed or confined spaces

- Air monitoring or sampling equipment to evaluate airborne concentrations of welding and cutting contaminants
- Respiratory protection when airborne concentrations of contaminants exceed regulatory limits

9.22.1 Compressed Gas Cylinders

- Cylinders being transported, moved, or stored shall have valve protection caps installed. When transported by motor vehicle, hoisted, or carried, cylinders shall be in the vertical position.
- Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials by a minimum of 20 feet (6.1 meters) or by a noncombustible barrier at least 5 feet (1.5 meters) high and with a fire-resistant rating of at least 1 half hour.
- Inside of buildings, cylinders shall be stored in well-ventilated, dry locations at least 20 feet (6.1 meters) from highly combustible materials. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage areas shall be located where cylinders will not be knocked over or damaged.
- During use, cylinders shall be kept far enough away from the actual welding and cutting operations to prevent sparks, hot slag, or flames from reaching them. When this is impractical, fire-resistant shields shall be provided.
- Cylinders containing oxygen or fuel-gas shall not be taken into confined spaces.
- If cylinders are frozen, warm (not boiling) water shall be used to thaw them.

9.22.2 Welding and Cutting Equipment

- Fuel-gas and oxygen hoses shall be easily distinguishable from each other and shall not be interchangeable between fuel-gas and oxygen.
- Hoses shall be inspected at the beginning of each shift. Defective hoses shall be removed from service.
- Hose couplings shall be designed to be disconnected with a rotary motion, not by straight pull.
- Torches shall be inspected at the beginning of each shift for leaking valves, connections, and couplings. Defective torches shall be removed from service.
- Torches shall be ignited with friction lighters, not open flames or hot work.

9.22.3 Arc Welding and Cutting

- Only manual electrode holders that are designed for arc welding or cutting and are capable of safely handling the maximum rated current shall be used.
- Only cable that is free from repair or splices for a minimum distance of 10 feet (3 meters) from the cable's attachment to the electrode holder shall be used.
- Any current-carrying part that arc welders or cutters grip in their hand, as well as the outer surfaces of the jaws of the holder, shall be fully insulated against the maximum voltage encountered to ground.
- The frames of arc welding or cutting machines shall be grounded. Grounding circuits, other than by means of the structure, shall be checked to ensure that the circuit between the ground and the grounded power conductor has resistance low enough to permit sufficient current flow to cause the fuse or circuit breaker to interrupt the current.
- When electrode holders are left unattended, the electrode shall be removed and the holder placed where it cannot harm employees.
- Hot electrode holders shall not be dipped in water to cool them.

- When welding or cutting is stopped for any appreciable length of time, or before the welding or cutting machine is moved, the power shall be shut off.
- Before starting welding or cutting operations, all connections to the machine shall be checked.

9.22.4 Toxic Fumes and Gases

- General mechanical or local exhaust ventilation shall be provided when welding or cutting in a confined space.
- Contaminated air exhausted from the work area shall be discharged into the open air or otherwise clear of the intake air.
- Other employees exposed to the same atmosphere as the welder or cutter shall be protected in the same manner as the welder or cutter.
- In enclosed spaces, all surfaces covered with toxic preservative coatings shall be stripped to a distance of at least 4 inches from the area to be heated, or the worker shall be protected with an air-line respirator.
- Welding or cutting in an enclosed space shall be performed with local exhaust ventilation or air-line respirators when the following metal bases, fillers, or coatings are involved: lead, cadmium, mercury, zinc, stainless steel, or beryllium.
- Employees welding or cutting in the open air and who are exposed to the metals noted above shall be protected with filter-type respirators; however, when working with beryllium, the employee shall be protected with an air-line respirator.

9.22.5 Fire Prevention

- When the potential for an explosive atmosphere exists in the immediate area of welding or cutting operations, air-monitoring instruments shall be used to verify that no explosive atmosphere is present before or during welding or cutting operations.
- When welding or cutting on walls, floors, or ceilings, the same precautions shall be taken on the opposite side as on the welding or cutting side.
- Whenever openings or cracks in the floor, walls, or doorways cannot be closed, precautions shall be taken to prevent combustible materials in other areas from coming in contact with sparks.
- To prevent fire in enclosed spaces, the gas supply to the torch shall be shut off at some point outside the enclosed space whenever the torch is not in use or is left unattended.
- Drums or hollow structures that have contained toxic or flammable substances shall be filled with water or thoroughly cleaned, ventilated, and tested before welding or cutting on them.
- Before heat is applied to a drum, container, or structure, a vent or opening shall be provided to release built-up pressure during the application of heat.
- Before welding or cutting on any surface covered by a preservative coating whose flammability is unknown, a competent person shall test its flammability.
- Preservative coatings shall be considered highly flammable when scrapings burn rapidly.
- When preservative coatings are found to be highly flammable, they shall be stripped from the area to be heated.

9.23 Working Around Material-handling Equipment

When CH2M HILL personnel are working around to material-handling equipment, the following safe work practices/hazard controls shall be implemented:

- Never approach operating equipment from the rear. Always make positive contact with the operator, and confirm that the operator has stopped the motion of the equipment.
- Never approach the side of operating equipment; remain outside of the swing and turning radius.

- Maintain distance from pinch points of operating equipment.
- Never turn your back on any operating equipment.
- Never climb onto operating equipment or operate contractor/subcontractor equipment.
- Never ride contractor/subcontractor equipment unless it is designed to accommodate passengers and equipped with firmly attached passenger seat.
- Never work or walk under a suspended load.
- Never use equipment as a personnel lift; do not ride excavator buckets or crane hooks.
- Always stay alert and maintain a safe distance from operating equipment, especially equipment on cross slopes and unstable terrain.
- Wear a high-visibility safety vest or high-visibility clothing.

SECTION 10

Physical Hazards and Controls

Physical hazards include exposure to temperature extremes, sun, noise, and radiation. If you encounter a physical hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made.

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 exposure 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 develop feasible engineering controls. When engineering controls are not feasible, administrative controls can be developed and appropriate hearing protection will be provided.
- In areas or near equipment emitting noise levels at or above 85 dBA, hearing protection must be worn.
- Employees exposed to 85 dBA or a noise dose of 50 percent 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 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 VO.
- Hearing protection will be maintained in a clean and reliable condition, inspected before use and after any occurrence to identify any deterioration or damage, and damaged or deteriorated hearing protection will be 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, and a copy of the OSHA standard 29 CFR 1910.95 shall be posted in the workplace.

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.

10.2.1 Limit Exposure Time

- Rotate staff members 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.

10.2.2 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.

10.2.3 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. Wraparound- style glasses provide the best protection.

10.2.4 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. Most dermatologists advocate a sun protection factor of 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

(Reference CH2M HILL SOP HSE-211, *Heat and Cold Stress*)

Each employee is responsible for the following:

- Recognizing the symptoms of heat or cold stress
- Taking appropriate precautionary measures to minimize the risk of exposure to temperature extremes (see following sections)
- Communicating any concerns regarding heat and cold stress to the 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, less physiological strain is experienced, the heart rate and body temperature are lower (the latter indicates less retained body heat—a rise in internal temperature precipitates heat injury), and the sweating mechanism is more efficient.

Acclimatization is the degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions. Acclimatization affects the 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 evaluating 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	Move 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.	Move to cooler area. Rest lying down. Increase fluid intake.	Move 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°F to 60°F should be made 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, 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°F 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°F. Although it provides an accurate indication of heat stress, oral temperature is difficult to measure in the field.

Procedures for when Heat Illness Symptoms are Experienced

- **Always** contact the RHSM when any heat illness-related symptom is experienced so that controls can be evaluated and modified, if needed.
- In the case of cramps, reduce activity, increase fluid intake, move to shade until recovered.
- In the case of all other heat-related symptoms (fainting, heat rash, heat exhaustion), and if the worker is a CH2M HILL worker, contact the occupational physician at 1-866-893-2514 and immediate supervisor.
- In the case of heat stroke symptoms, call 911, have a designee give location and directions to ambulance service if needed, follow precautions under the emergency medical treatment of this HSP.
- Follow the directions provided in Section 22, Incident Notification, Reporting, and Investigation, of this HSP.

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. As a result, 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.

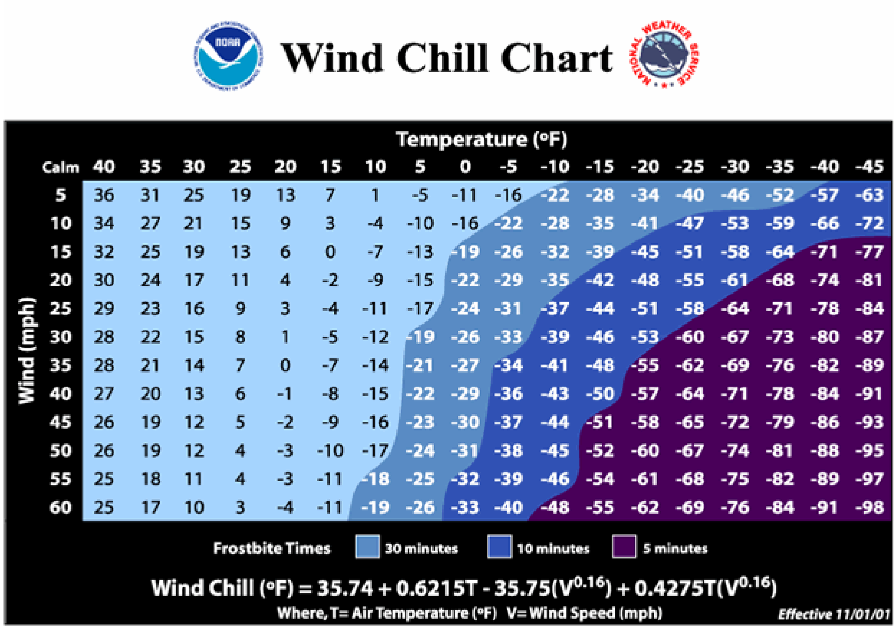
Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.

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.
- Use the wind-chill index (illustrated below) 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.
- Report initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to your 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 as well as 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

Temperature (°F)

Wind (mph) / 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

10.4 Radiological Hazards

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

Hazards	Controls
None Known	None Required

SECTION 11

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 contact, 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 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.

11.2 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.

11.3 Feral Dogs

Avoid all dogs – both leashed and stray. Do not disturb a dog while it is sleeping, eating, or caring for puppies. If a dog approaches to sniff you, stay still. An aggressive dog has a tight mouth, flattened ears, and a direct stare. If you are threatened by a dog, remain calm, do not scream, and avoid eye contact. If you say anything, speak calmly and firmly. Do not turn and run, try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (for example, a vehicle). If attacked, retreat to vehicle or attempt to place something between you and the dog. If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck and protect your face. If bitten, contact the occupational nurse at 1-866-893-2514. Report the incident to the local authorities.

11.4 Mosquito Bites

Due to the recent detection of the West Nile virus in the southwestern United States, preventative measures should 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) because mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35 percent DEET. Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, 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 RHSM with questions, and immediately report any suspicious symptoms to your supervisor and the PM, and contact the occupational nurse at 1-866-893-2514.

11.5 Poison Ivy, Poison Oak, and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are found more commonly 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 at any time, especially in dry areas. Leaves may achieve bright reds in fall, but plants lose their (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 the roots, once aboveground 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 urishiol 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, or 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 they will come into contact with poison ivy, sumac, or oak. Vehicles that 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 onsite decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.
- PPE, including Tyvek coveralls, gloves, and boot covers, must be worn. PPE must be placed into plastic bags and sealed if 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 because the oils can form an 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.

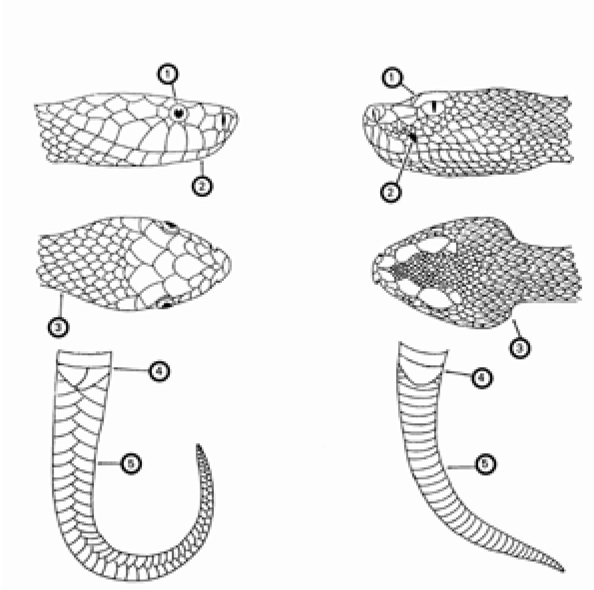
If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514.

11.6 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 2. No sensing pit 3. Head slightly wider than neck 4. Divided anal plate 5. Double row of scales on the underside of the tail	1. Elliptical pupils 2. Sensing pit between eye and nostril 3. Head much wider than neck 4. Single anal plate 5. Single scales on the underside of the tail



11.7 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 and 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.
- 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

11.8 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 1/4 inch (6.4 mm) in size.

Ticks present a year-round hazard for field staff at MCB CamLej. There is some potential for ticks to be present in low grasses, mown lawns, or low tree branches, but they are more likely to be present in wooded areas, bushes, tall grass, and brush. Ticks thrive in tall weeds and grass. Adults will climb into shrubs at shin to waist heights, nymphs are picked up at shin to knee heights, and larvae are typically picked up at shoe levels.

11.8.1 Clothing Options

Several clothing options are available for tick prevention, as described below.

- **Self-applied Clothing Treatment –** Permethrin-based repellents such as Permanone have proven to be highly effective in preventing tick bites. Permethrin is actually an insecticide, rather than a traditional repellent, and works primarily by killing ticks on contact with the clothes (although it also has some repellent properties). Repellents containing permethrin are for use on clothing only and are not intended for skin application. These products are formulated as aerosol sprays or pumps, and will typically provide up to 2 weeks of protection from a single treatment (lasting through several washings). Instructions on product labels should be followed for proper application. Typically, these products are applied in a well-ventilated area and allowed to dry for 2 to 4 hours (more time is required for higher-humidity environments). Although skin reactions are not common, it is recommended to avoid contact with face, eyes, or skin when treating clothing.

- **Pretreated Clothing** - Some manufacturers produce clothing that has already been treated with Permethrin. Typically, the fibers are impregnated with the repellent, reportedly making them able to withstand up to 70 wash cycles. Purchasing pre-treated clothing is one alternative to applying a Permethrin-based repellent to your clothing.
- **Bug Suits** – Bug suits are garments assembled with a mesh foundation woven throughout the pants and jacket, along with a mesh/fabric hood. These provide a physical barrier to small insects (including ticks and chiggers). Typically, these garments are not treated with repellents and still are susceptible to infiltration through seams. Additionally, mesh hoods may impair vision. Bug suits add an additional layer of clothing to the wearer, and may result in increased heat stresses to the body. Bug suits are an approved alternative to treated clothing, but particular attention must be paid to seams, vision impairment, and heat stress when they are worn for tick bite prevention. Bug suits should not be used around heavy equipment or moving parts that could catch the material and pull an individual into the equipment.
- **Tyvek Suits** – Tyvek suits provide a continuous physical barrier for the legs and torso, which makes it very difficult for ticks to infiltrate. The light color also makes it easier to see ticks that have transferred onto the body. The disposable nature of Tyvek also reduces the hazard associated with ticks that go undetected in clothing at the end of the day. Tyvek clothing presents an additional heat stress hazard for employees, which may make use difficult at MCB CamLej in late spring through early fall.

11.8.2 Skin Treatment

The use of skin-applied repellents is required when working in areas where the presence of ticks is anticipated. Although other repellents may provide some level of protection, DEET-based repellents are preferred for use on CH2M HILL projects. However, alternative repellents that can be used must include one of the following active ingredients: Picaridin, IR3535, oil of lemon eucalyptus (also known as PMD), IR3535, methyl nonyl ketone, and oil of citronella.

These repellents must be reapplied periodically in accordance with manufacturer’s recommendations. The effectiveness of DEET on the skin is influenced by the concentration of DEET, absorption through the skin, evaporation, sweating, air temperature, wind, and abrasion of the treated surface by rubbing or washing. Studies have shown that 100 percent DEET may offer up to 12 hours of protection, while lower concentrations of DEET (20 percent-34 percent) may provide between 3 to 6 hours of protection. The Center for Disease Control and Prevention recommends repellents with between 20 percent-30 percent DEET content. Some non-DEET repellent products also provide some level of protection, but to a lesser degree than DEET- based products. DEET will repel ticks and decrease the chance of a tick bite, but it may not deter a tick from walking across the skin to unexposed and untreated areas.

Active Ingredients in Insect Repellents

Conventional Repellents

- DEET is the active ingredient found in many insect repellent products. It is used to repel biting pests such as mosquitoes and ticks, including ticks that may carry Lyme disease. Products containing DEET currently are available to the public in a variety of liquids, lotions, sprays, and impregnated materials (for example, wrist bands). Formulations registered for direct application to human skin contain from 4 to 100 percent DEET. Picaridin (chemical name, 2-[2-hydroxyethyl]-1-piperidinecarboxylic acid 1-methylpropyl ester) is a colorless, nearly odorless liquid active ingredient that is used as an insect repellent against biting flies, mosquitoes, chiggers, and ticks. Picaridin products were sold in Europe and Australia for several years before being introduced to the U.S. market in 2005. Products contain a range of 5 to 20 percent of the active ingredient.

Biopesticide Repellents

- Biopesticides are certain types of pesticides derived from natural materials such as animals, plants, bacteria, and certain minerals. These include: IR3535 (chemical name, 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester), also called Merck 3535, oil of lemon, P-Mentane-3,8-diol (the chemically synthesized version of oil of lemon eucalyptus), methyl nonyl ketone, and oil of citronella.

Repellents Used on Clothing

- Permethrin is registered for use as both an insecticide and a repellent. Permethrin products are used on clothing, shoes, bed nets, and camping gear. Permethrin-impregnated clothing such as pre-treated shoes, socks, and pants repel and kill ticks, mosquitoes, and other insects and retain this effect after repeated laundering. Permethrin is also found in treated tents, tarps, bed nets, sleeping bags, and mattresses.

11.8.3 Required Protective Actions

Ticks can come in contact with skin anywhere that there is an uncovered area or an opening. Tyvek suits and bug suits provide continuous protection from the legs to the upper torso. The following actions are required for CH2M HILL employees when working in potential tick habitats at MCB CamLej:

- Wear light colored clothing.
- Wear long sleeves and long pants .
- Tuck shirts into pants; shirts should be long enough to not come untucked easily.
- Tuck pants into socks or tape pant legs to boots (close cuff openings).
- Remove clothing within 1 hour of being in the woods (and shower soon afterwards).
- Place clothes in hot dryer for 1 hour (or in sealed plastic bag).
- Apply repellents (both skin and clothing repellents).

TICKS- REQUIRED PROTECTIVE MEASURES	
Body Part	**Protective Measure**
Head	Light colored hat (recommended) Treat neck with approved repellent (required)
Upper Body	Light-colored long-sleeve shirt (required) Treat exposed skin with approved repellent (required) One of the following must be used: 1) Permethrin clothing treatment 2) Tyvek coverall 3) Bug suit
Lower Body	Long pants (required) One of the following must be used: 1) Permethrin clothing treatment 2) Tyvek coverall 3) Bug suit

11.8.4 Tick Checks

By checking ourselves and others for ticks, ticks may be located and removed before they have a chance to attach or transfer diseases. The field personnel will conduct personal checks often; and at lunch and the end of the day, they will perform a full-body check for ticks.

11.8.5 Tick Bite and Removal

If bitten by a tick, act promptly. Remove the tick immediately, using tweezers and pulling gently at the point of attachment (head). It is essential to remove the tick as soon as possible (best if found and removed within 24 hours of attachment). Wash your hands and skin after removing the tick. Place the tick in a resealable plastic bag for testing at a later date. Call the occupational nurse at 1-866-893-2514 as soon as possible, and provide as much information as possible regarding the date, time, and location of the bite. Report the tick bite to your supervisor and PM. Complete the Hours and Incident Tracking System (HITS) report. Follow the nurse's advice regarding monitoring symptoms and follow-up contact.

Be aware of the symptoms of Lyme disease or RMSF. Lyme disease begins with a rash that looks like a bullseye with a small welt in the center. RMSF begins with 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, contact the occupational nurse at 1-866-893-2514 and seek medical attention.

Take precautions to avoid exposure by including pre-planning measures for biological hazards before starting field work. Avoid habitats where possible and 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 before 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 the 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 sure to complete an Incident Report (either use the HITS on the VO) if you do come in contact with a tick.

SECTION 12

Contaminants of Concern

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

Contaminants of Concern

Contaminant	Location and Maximum[a] Concentration	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Arsenic	GW:32.2 SB:4.9 SS:9.58 SD: 2.16	0.01 mg/m^3	5 mg/m^3 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Bis(2-ethylhexl)phthalate	GW:3.3 SB: ND SS: ND SD:2 SW: 2.53	5 mg/m^3	5000 mg/m^3 Ca	irritation eyes, mucous membrane; in animals: liver damage; teratogenic effects; [potential occupational carcinogen]	UK
Chloroform	GW: 28 SB: ND SS: ND	2 ppm	500 Ca	Dizziness, mental dullness, nausea, confusion, disorientation, headache, fatigue, eye and skin irritation, anesthesia, enlarged liver	11.42
Chromium (as Cr(II) & Cr(III))	GW:3.31 SB:22.2 SS:19.5 SD: 17.8 SW:1.09	0.5 mg/m^3	25 mg/m^3	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Cobalt (Metal, Dusts, and Fumes)	GW:35.9 SB: SS:	0.05 mg/m^3	20 mg/m^3	Coughing, difficulty breathing, wheezing, decreased pulmonary function, diffuse nodule fibrosis, dermatitis, respiratory hypersensitivity, asthma	NA
Cyanide	GW: SB: ND SS:0.546	5 mg/m^3	25 mg/m^3	Asphyxia and death can occur, preceded by seizures, coma with abolished deep reflexes and dilated pupils, weakness; paralysis; dizziness; numbness; anxiety; chest tightness; irregular heartbeat; shortness of breath; confusion; headache; sore throat; nausea, vomiting; eye irritation; rash, chemical burns on skin; enlargement of thyroid gland.	NA
2,4-Dinitrotoluene	GW:ND SB:ND SS: ND SD:11	1.5 mg/m^3	50 mg/m^3 Ca	Anoxia, cyanosis; anemia, jaundice; reproductive effects; [potential occupational carcinogen]	UK
Lead	GW: SB:290 SS:35,500	0.05 mg/m^3	100 mg/m^3	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

Contaminants of Concern					
Contaminant	**Location and Maximum[a] Concentration**	**Exposure Limit[b]**	**IDLH[c]**	**Symptoms and Effects of Exposure**	**PIP[d] (eV)**
Mercury	GW: SB: SS:0.34	0.05 mg/m^3	10 mg/m^3	Skin and eye irritation, cough, chest pain, difficult breathing, bronchitis, pneumontitis, tremors, insomnia, irritability, indecision, headache, fatigue, weakness, GI disturbance	
Nitrobenzene	GW:0.48 SB: ND SS: ND	1 ppm	25	Toxic by skin exposure. Skin, eye, and mucous membrane irritant. Respiratory disruption. Anemia	9.92
Nitroglycerine	GW: ND SB: ND SS:1,870	0.2 ppm	75 mg/m^3	Throbing head, dizziness, nausea, abdominal pain, hypertension, flushing, palpatations, delirium, CNS depressant, angina, skin irritation	NA
Vanadium	GW: SB:46.4 SS:1.08	0.5 V/ m^3	35 mg/m^3	Eyes, skin, and throat irritant, green tongue, metallic taste in mouth, eczema, cough, fine rales, wheezing, bronchitis	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water).
[b] Appropriate value of PEL, recommended exposure limit (REL), or threshold limit valute (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.

eV = electron volt
mg/kg = milligram per kilogram
mg/m^3 = milligrams per cubic meter

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (for example, wash hands and face before drinking or smoking).

SECTION 13

Site Monitoring

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

When performing site monitoring, record all the information in a field logbook or equivalent. 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 project team members' employment plus 30 years. Ensure that copies of the field logbook are maintained in the project file.

Copies of all project exposure records (for example, copies of field logbook pages where air monitoring readings are recorded and associated calibration) shall be sent to the RHSM 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
FID: OVA model 128 or equivalent **PID:** MiniRAE PID with 11.7 eV lamp or equivalent	Soil sampling, drilling and other intrusive work	<1 ppm 1 to 10 ppm > 10 ppm	Level D Level C Evacuate work area and contact RHSM	Initially and periodically during task	Daily
CGI: MSA model 260 or 261 or equivalent	Soil sampling, drilling and other intrusive work	0-10% : 10-25% LEL: >25% LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Initially and periodically during task	Daily
O_2Meter: MSA model 260 or 261 or equivalent	Soil sampling, drilling and other intrusive work	>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Initially and periodically during task	Daily
Dust Monitor: DataRAM or equivalent	Site UXO-14 Soil sampling; other intrusive work All other sites- Soil sampling, drilling and other intrusive work	<0.5 mg/m^3 > 0.5 mg/m^3 <1.0 mg/m^3 >1.0 mg/m^3	Level D Start dust suppression, if dust levels do not fall below action level, Stop work and call RHSM Level D Start dust suppression	Continuously during task Initially and periodically during task	Zero Daily
Noise-Level Monitor [d]	High noise work	<85 dBA 85-120 dBA 120 dBA	No action required Hearing protection required Stop; re-evaluate	Initially and periodically during task	Daily

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the 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.

FID = flame ionization detector; PID= photoionization detector; ppm = parts per million:

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 11.7 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg[1] T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing
FID: OVA	100 ppm methane	3.0 $\pm$ 1.5	100 ppm	1.5 lpm reg T-tubing
FID: TVA 1000	100 ppm methane	NA	100 ppm	2.5 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
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL $\pm$ 5% LEL	1.5 lpm reg direct tubing
Multi-gas: MultiRae or equivalent	H2S CO LEL O2 100 ppm isobutylene	CF = 25 CF = 50 CF = 50 CF = 20.9 CF = 100	25 ppm 50 ppm 50 % 20.9 % 100 ppm	1.5 lpm reg T-tubing
GEM 2000 (or equivalent)	Methane, O_2	Various	Refer to Instrument Manual on site,	

[1]Liters per minute, regulator

Calibrate air monitoring equipment daily (or before 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

SECTION 14

Personal Protective Equipment

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

14.1 Required PPE

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 who approved this plan. The items below need to be followed when using any form of PPE:

- Employees must be trained to properly wear and maintain the PPE.
- Employees must be trained in the limitations of 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 before use and after any occurrence to identify any deterioration or damage.
- PPE must be maintained in a clean and reliable condition.
- Damaged PPE shall not be used and must either be repaired or discarded.
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

The table below outlines the 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 PPE Requirements[a]

Task	Level	Body	Head	Respirator [b]
General site entry Surveying Surface soil sampling	D	Work clothes; safety-toed leather work boots and gloves	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required
Monitoring Well Installation /Geoprobe boring Soil, Surface Water, Sediment, Groundwater sampling Soil boring IDW sampling and disposal	Modified D	Work clothes or cotton coveralls (Uncoated Tyvekif contact with dusts cannot be avoided, Polycoated Tyvekif contact with water cannot be avoided) **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required
Site UXO-14 – Soil and Soil boring IDW sampling and disposal	Modified D	**Coveralls:** Uncoated Tyvek® **Boots:** Safety-toe, chemical-resistant boots OR safety-toe, leather work boots with outer rubber boot covers	Hardhat [c] Splash shield [c] Safety glasses with side shields	None required.

Project-Specific PPE Requirements[a]

Task	Level	Body	Head	Respirator [b]
		Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Ear protection [d]	
Work near vehicular traffic ways or earthmoving equipment.	All	Appropriate level of ANSI/ISEA 107-2010 high-visibility safety vests.	Hardhat [c] Splash shield [c] Safety glasses with side shields Ear protection	None required.
Equipment decontamination if using pressure washer	Modified D with splash protection	**Coveralls:** Polycoated Tyvek **Boots:** 16-inch-high steel-toed rubber boots **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] over safety glasses with side shields or splash goggles Ear protection [d]	None required.
Contact RHSM	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	Air-purifying respirator, full face, MSA Ultratwin 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 identified 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 (for example, 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 when using respiratory protection:

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators use and Level B training is required for supplied-air respirators and SCBA use. Specific training is required for the use of powered air-purifying respirators..
- Respirator users must complete the respirator medical monitoring protocol and be 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 Self-Assessment Checklist – Respiratory Protection included in as attachment to this plan to verify compliance with CH2M HILL's respiratory protection program.

SECTION 15

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 HAZWOPER activities shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall consist 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 HAZWOPER activities.

15.1.2 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 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.

15.1.3 Three-Day Actual Field Experience

General site workers for hazardous waste operations shall receive 3 days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor and the training 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.

15.1.4 Refresher Training

General site workers and treatment, storage, and disposal workers shall receive 8-hours of refresher training annually (within the previous 12-month period) to maintain qualifications for field work. 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.

15.1.5 Eight-Hour Supervisory Training

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

15.1.6 First Aid/CPR

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 VO is also required for those designated as first aid-/CPR-trained.

15.1.7 SC 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 complete additional safety training required by the specific work activity on the project that qualifies them to implement the HSE program (for example, fall protection or excavation).

15.1.8 Site-Specific Training

Before field activities begin, 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 ask for clarification about anything they do not understand and to reinforce their responsibilities regarding safety and work operations for their particular activity.

15.1.9 Project-Specific Training Requirements

Project-specific training for this project includes:

- Training on this and subcontractor HSPs/AHAs
- Training qualifications outlined in SOP HSE-610, *Explosives Usage and Munitions Response* (for all UXO personnel)
- Training on SOPs on the VO as applicable:
  - Arsenic
  - Chromium
  - Drum Handling
  - Electrical Safety
  - Lead Exposure (Site UXO-14)
  - LO/TO
  - Manual Lifting
  - Traffic Safety

SECTION 16

Medical Surveillance and Qualification

(Reference CH2M HILL SOP HSE-113, *Medical Surveillance*)

All site workers participating in HAZWOPER activities 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 (for example, physician's written opinion) will be maintained in the project files and made available for inspection.

16.1 HAZWOPER Activities

CH2M HILL personnel expected to participate in onsite HAZWOPER tasks 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's health at increased risk of material impairment by performing HAZWOPER tasks or from respirator use.

16.2 Job or Site-specific Medical Surveillance

Because of 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 may include monitoring lead workers if dust cannot be suppressed below action levels.

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 are subject to the requirements of 29 CFR 1910.95 and exposed to noise levels in excess of the 85dBA time-weighted average shall participate in a hearing conservation program that includes annual audiometric testing.

SECTION 17

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 that include the following items:

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

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 Exclusion Zone (EZ), Contamination Reduction Zone (CRZ), and an 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 during task planning and 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 who 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 various levels of protection to be employed or various 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 because of 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, or reinforced caution tape or rope) as necessary and posted with appropriate signage.

SECTION 18

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 EZ 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 EZ or decontamination zone. 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.
- Minimize the number 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 when 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.

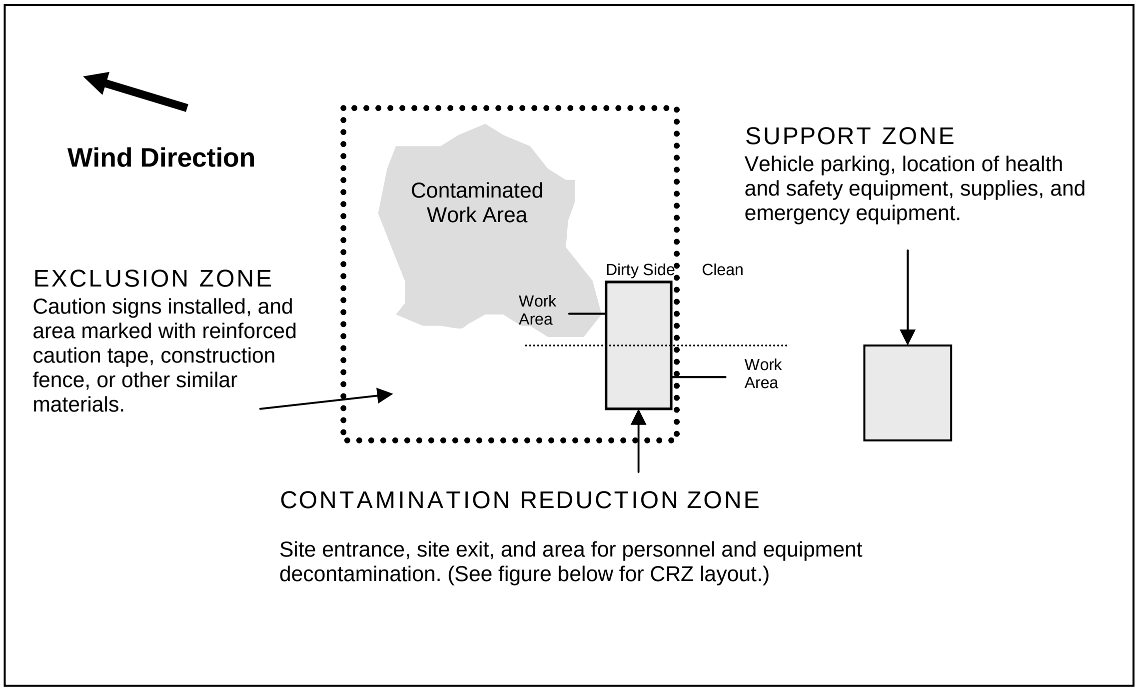
18.4 Waste Collection and Disposal

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

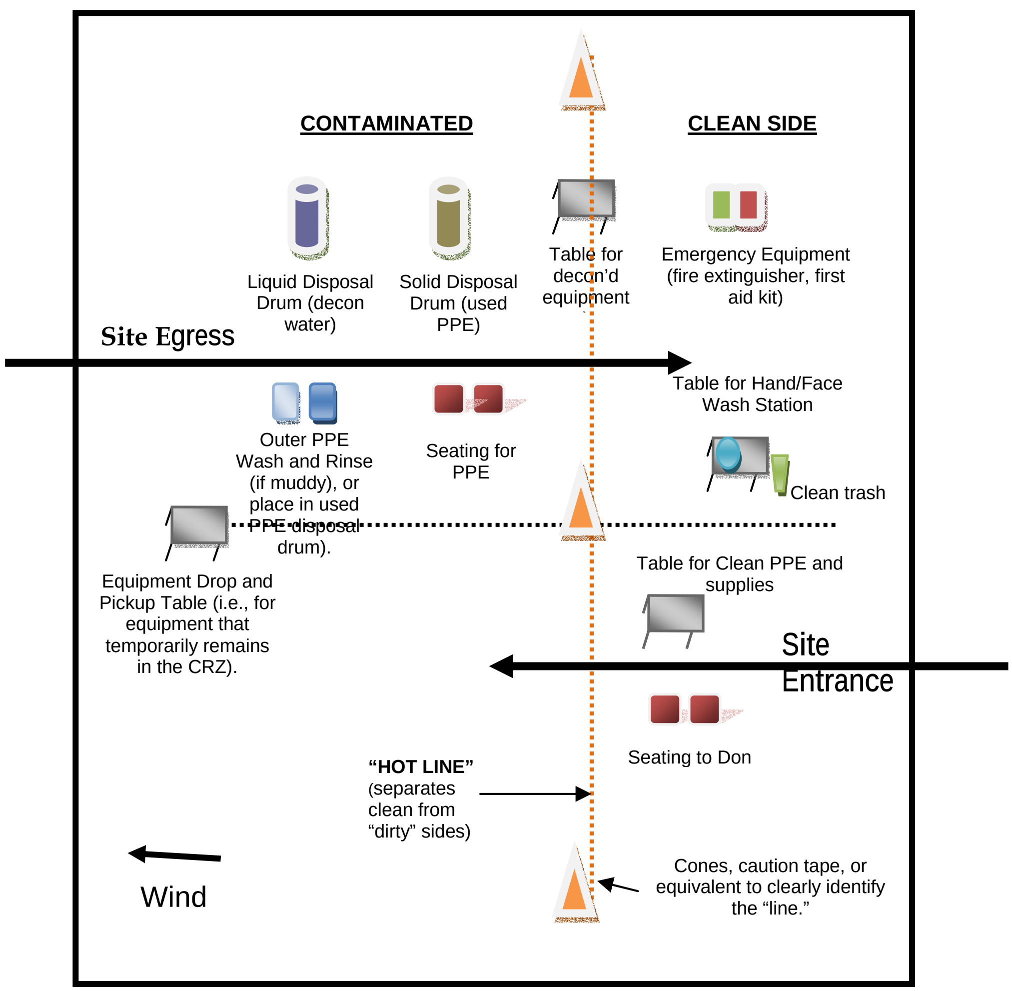
18.5 Diagram of Personnel-Decontamination Line

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



SECTION 19

Emergency Response Plan

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

19.1 Pre-Emergency Planning

The 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.
- Find out what onsite communication equipment is available (two-way radio, air horn).
- Identify what offsite communication equipment is needed (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 information about 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.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases to project personnel.
- Rehearse the emergency response plan before site activities begin. This may include a “tabletop” exercise or an actual drill depending on the nature and complexity of the project. Drills should take place periodically but at least once a year.
- Brief new workers on the emergency response plan.
- Evaluate emergency response actions and initiate appropriate follow-up actions.

19.2 Emergency Equipment and Supplies

The ERC shall ensure the following emergency equipment is on the site. Verify and update the locations of this equipment as needed. The equipment will be inspected in accordance with manufacturer’s recommendations. The inspection shall be documented in a field logbook or similar means to be kept in the project files.

Emergency Equipment and Supplies	Location
20-lb (or two 10-lb) fire extinguisher (A, B, and C classes)	Support Zone/Heavy Equipment
First aid kit	Support Zone/Field Vehicle

Eye wash	Support & Decon Zone/Field Vehicle
Potable water	Support & Decon Zone/Field Vehicle
Bloodborne-pathogen kit	Support Zone/Field Vehicle
Additional equipment (specify):	

19.3 Incident Response

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

- 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 client 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 or heart has stopped). When in doubt as to whether an injury is life-threatening, 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; 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 and complete incident report using the HITS system on the VO 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 Section 22, Incident Notification, Reporting and Investigation, 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, such as 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 because 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 and 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.

Emergency Contacts

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.

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

Medical Emergency – 911 **Hospital ER (On-Base) #: (910) 451-4840** **(910) 451-4841** **(910) 451-4842** **Onslow County ER (Off-Base) #:(910) 577-2240** **Ambulance (On-Base) #: (910) 451-3004** **(910) 451-3005** **Ambulance (Public) #: (910) 451-9111** **LEPC (Poison Control)#: (800) 222-1222#:**	**CH2M HILL- Medical Consultant** 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 **Base 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 **Base Security #: (910) 451-2555**	**CH2M HILL Responsible Health and Safety Manager (RHSM)** Name: Carl Woods/CIN Phone: (513) 889-5771
Utilities Emergency Phone Numbers Water: (910) 451-9111 Gas: (910) 451-9111 Electric: (910) 451-9111	**CH2M HILL Human Resources Department** Phone: Employee Connect toll-free number 1-877-586-4411 (U.S. and Canada)
CH2M HILL Project Manager Name: Keith LaTorre/KNX Phone: 865-769-3204	**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: TBD Phone:	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: (720) 286-2087
CH2M HILL Project Environmental Manager Name: Nancy Ballantyne Phone: (303) 885-9954	**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 the SC-HW

Facility/Site Evacuation Route(s): follow main roads towards access 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) 100 Brewster Blvd., Building NH100 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

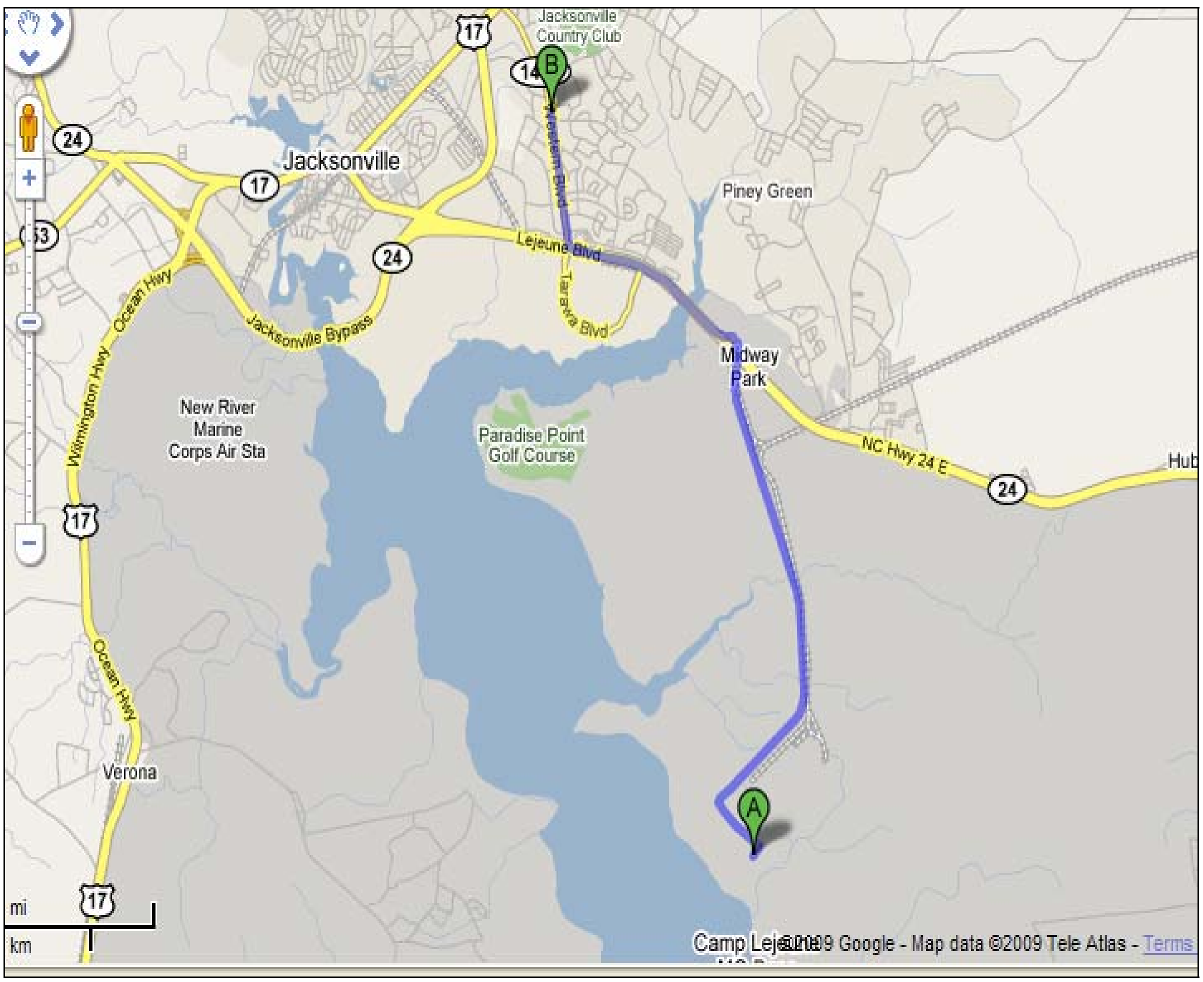
For Sites UXO-01 (ASR#2.23), UXO-01 (ASR #2.79a, b, and c), UXO-07, UXO-17, and UXO-21:

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

1. Proceed north 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:

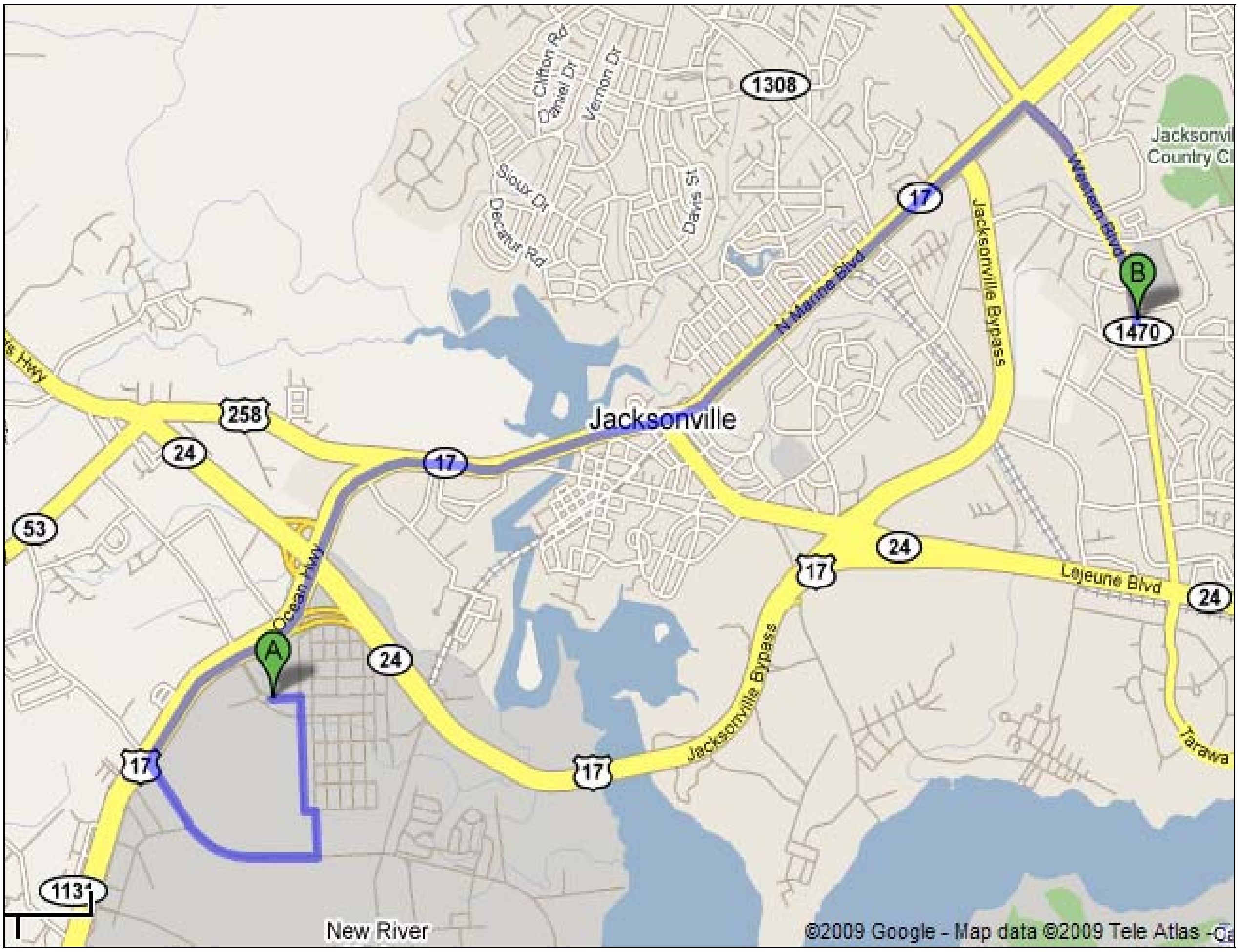
1. From Holcomb Boulevard, exit Base through main gate.
2. Follow Highway 24 west until intersecting with Western Boulevard.
3. Turn right onto Western Boulevard.
4. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth stop light) from Highway 24.
5. Follow the signs to the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



For Site UXO-11:

Directions to Onslow County Memorial Hospital:

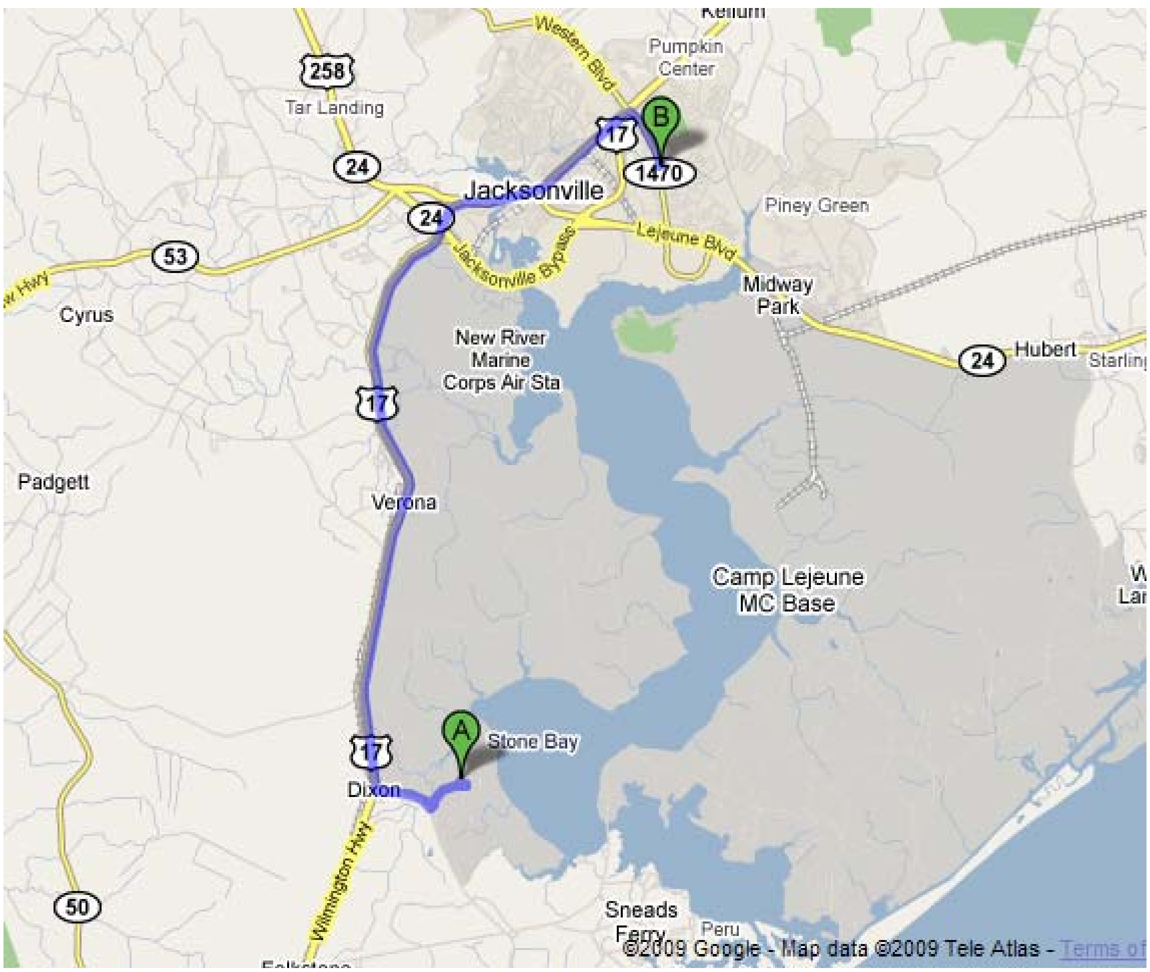
1. Proceed through the main gate, turn right, and head north on Ocean Highway 17.
2. Follow Ocean Highway 17 north to Highway 24 and head east.
3. Travel east until Western Boulevard, turn left onto Western Boulevard.
4. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth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



For Sites UXO-02 and UXO-14:

Directions to Onslow County Memorial Hospital:

1. Head south on Powder Lane toward Range Road.
2. Turn right onto Range Road
3. Turn right onto Stone Bay Road
4. Turn right onto NC-210/Rifle Range Rd/Sneads Ferry Rd
5. Turn right onto Ocean Highway 17
6. Follow Ocean Highway 17 north to Highway 24 and head east.
7. Travel east until Western Boulevard, turn left onto Western Boulevard.
8. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth stop light) from Highway 24.
9. Follow the signs to the emergency room.



SECTION 20

Spill Containment Procedures

CH2M HILL and subcontractor personnel working at the project site shall be knowledgeable of the potential HSE concerns associated with petroleum and other substances that could be released at the project site.

The following criteria 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 spill, notify emergency services. Personnel discovering a spill shall (only if safe to do so):

- Stop or contain the spill immediately (if possible) or note source. Shut off the source (for example, pump or treatment system) if possible. If unsafe conditions exist, then leave the area, call emergency services, inform nearby personnel, notify the site supervisors, and initiate incident reporting process. Notify the SC immediately.
- Extinguish sources of ignition (flames, sparks, hot surfaces, cigarettes).
- Clear personnel from the spill location and barricade the area.
- Use 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.
- Follow directions given in Section 22, Incident Notification, Reporting, and Investigation, of this plan.

SECTION 21
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. These 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.

- Arsenic
- Biological
- Chainsaw
- Drilling
- Forklifts
- Earthmoving Equipment
- Electrical
- Excavations
- Fall Protection
- Hand and Power Tools
- Lead
- LO/TO
- Manual Lifting
- PPE
- Traffic Control

21.2 Safe Behavior Observations

Safe Behavior Observations (SBOs) are 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.

SECTION 22

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 (for example, hitting a utility)
- Incidents that 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

22.2.1 Incident

An incident is an event that causes or could have caused undesired consequences. An incident may be caused by natural forces, employees, subcontractors, or third parties in any location associated with CH2M HILL operations, including offices, warehouses, project sites, private property, or public spaces. Incidents include:

- Injury or illness to a CH2M HILL employee or subcontractor employee, or member of the public
- Property damage
- Spill or release
- Environmental requirement or permit violation
- A near-miss
- Other (for example, fire, explosion, bomb threat, workplace violence, threats)

Accident: an incident involving actual loss through injury, damage to assets, or environmental harm.

22.2.2 Near-miss

A near-miss occurs when an intervening factor prevented an injury or illness, property damage, spill or release, permit violation, or other event from occurring. Examples of near-miss situations include: a hard hat or other PPE prevented an injury; secondary containment or emergency shutoff prevented a spill; or an alert co-worker prevented an incident.

22.2.3 Serious Incident

Serious incidents that must be immediately reported to senior management include the following:

- Work-related death, or life-threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public

- Kidnapped/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.

22.3 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 and Field Team Leader
- Date and time of incident
- Description of incident
- Extent of known injuries or damage
- Level of medical attention
- Preliminary root cause/corrective actions

The RHSM shall immediately inform the EM (or available alternate) of spills, potential environmental permit compliance, or any environmental situation that could result in a notice of violation from an agency.

The CH2M HILL team shall comply with all applicable statutory incident reporting requirements such as those to OSHA, the police, or state or federal environmental agency.

22.4 HITS and Incident Report Form

CH2M HILL maintains 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.

The SC shall complete an entry into the HITS database located on CH2M HILL's VO (or if VO not available, use the hard copy IRF and Root Cause Analysis Form and forward it to the RHSM) within 24 hours and finalize those forms within 3 calendar days.

22.5 Injury Management/Return-to-Work (for US/Puerto Rico-based CH2M HILL Staff Only)

(Reference CH2M HILL, SOP HSSE-124, *Injury Management/Return-to-Work*)

22.5.1 Background

The CH2M HILL 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 the 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 Injury Management/Return-to-Work Notification Process

- Employee informs his or her supervisor of an injury.
- Employee calls the Injury Management Program's toll-free number 1-866-893-2514 immediately and speaks with the occupational nurse. This number is operable 24 hours per day, 7 days a week.
- Supervisor ensures that employee immediately calls the Injury Management Program number. If necessary, supervisor makes the call with or for the injured worker.
- Nurse assists employee with obtaining appropriate medical treatment, as necessary, and schedules a clinic visit for employee (calls ahead, and assists with any necessary follow-up treatment). The supervisor or SC accompanies the employee if a clinic visit is necessary to ensure that employee receives appropriate and timely care.
- Supervisor or SC completes the HITS entry or IRF immediately (within 24 hours) and forwards it to the PM and RHSM.
- Nurse notifies appropriate CH2M HILL staff by e-mail (supervisor, Health & Safety, Human Resources, Workers' Compensation) of the injury.
- Nurse communicates and coordinates with and for employee on treatment through recovery.
- Supervisor ensures suitable duties are identified and available for injured or ill workers who are found 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 ensure timely notification and allow for positive control of information so that the incident is handled effectively, efficiently, and in conjunction with appropriate corporate entities. This standard notification process integrates HSSE and firm-wide security operations 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
- Kidnapped or 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 more 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 in order to 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 and RHSM. In addition, for spills, NOVs, and permit issues you may also call the EM.

CRISIS MANAGER:
If 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 OR Client Program HSE Manager, immediately notify the Responsible Environmental Manager (EM) for spills, NOVs, and permit issues, 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 OR 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 OR 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

Analysis is essential if all causes of an incident are to be identified in order that the correct remedial actions can be taken to prevent the same or similar type of incident from recurring. Root Cause Analyses (RCAs) shall be completed for all recordable injuries, property damage incidents in excess of $5,000, environmental permit violations, spills and releases that are required to be reported to regulatory agencies, and any other incident, including near-misses for which the RHSM or PM decides an RCA is appropriate. The RHSM/EM is responsible for ensuring each RCA is completed and the results entered in the IRF in HITS. RCAs must be completed by a team that includes, at least the RHSM or designee, the involved party(ies), a responsible operations representative (for example PM, construction manager, or crew supervisor), and an independent management representative not associated with the incident.

The RCA 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, identify 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 task is especially important when the investigation team will not be able to review the loss scene.

The investigation team must follow the Root Cause Analysis Flow Chart (see Appendix E of the Work Plan) 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, and 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."

Personal factors include:

- 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

Job factors include:

- 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 cited rarely and only after a thorough review eliminates all seven other factors.

22.7.1 Corrective Actions

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident IRF. 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 IRF 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.

- Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM, EM, or FTL.
- Incident investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.

SECTION 23

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 HSP. 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 such as air monitoring data (including calibration records), MSDSs, and exposure modeling results
- Physical hazard exposure records such as noise levels, ionizing radiation, non-ionizing radiation, vibration, and laser exposure assessments and measurements
- Respiratory fit test records
- Training records
- Incident reports, investigations, and associated backup information such as agency notifications, calculations, and corrective actions taken
- 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
  - Emergency equipment inspection records
  - 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.

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: **Project Number:**

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

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location: CTO-WE41 / MCB CamLej, Multiple MMRP Sites

HCC:

☐ Office ☐ Warehouse ☐ Laboratory ☒ Project:

Project No.: 418824

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)
Nitric acid	Support Zone / sample bottles		
Methanol	Support/Decon Zones		
Hexane	Support/Decon Zones		
pH buffers	Support Zone		
MSA Sanitizer	Support/Decon Zones		
Alconox/Liquinox	Support/Decon Zones		

MSDS for the listed products will be maintained at:

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

Arsenic
Biological
Chainsaw
Drilling
Forklifts
Earthmoving Equipment
Electrical
Excavations
Fall Protection
Hand and Power Tools
Lead
LO/TO
Manual Lifting
Personal Protective Equipment
Traffic Control

CH2MHILL

HSE Self-Assessment Checklist—Arsenic

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 exposed to arsenic, or are required to perform oversight of a subcontractor whose personnel are exposed to arsenic.

CH2M HILL staff shall not direct the means and methods of subcontractor arsenic activities nor direct the details of appropriate 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:

☐ Evaluate CH2M HILL compliance with its Arsenic program (SOP HSE-501)
☐ Evaluate a CH2M HILL subcontractor's compliance with its Arsenic program
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.

SECTION 1

	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (5.1)				
COMPLIANCE PROGRAM (5.1.1)				
1. Where EL ≥ PEL, a written compliance program is implemented before commencing work	☐	☐	☐	☐
2. The compliance program is based on the most recent air monitoring/sampling results.	☐	☐	☐	☐
3. The compliance program is updated for new exposure monitoring data or every six months.	☐	☐	☐	☐
4. Written compliance program is available to all affected employees.	☐	☐	☐	☐
5. Waste generated must be determined if considered hazardous waste.	☐	☐	☐	☐
EMPLOYEE INFORMATION (5.1.2)				
6. Training on the Hazard Communication Standard has been met.	☐	☐	☐	☐
7. CH2M HILL personnel have completed the Arsenic Training Module.	☐	☐	☐	☐
8. Training on the Fact Sheet, HSP/FSI, and OSHA standard has been met.	☐	☐	☐	☐

	Yes	No	N/A	N/O
9. The selection of the appropriate respirator is based on the airborne arsenic concentration.	☐	☐	☐	☐
10. Personnel working near arsenic-contaminated soil or material shall use wet methods and work practices to control dust; wear disposable coveralls, and exercise personal hygiene practices.	☐	☐	☐	☐
11. Contact lenses are not to be worn when working with arsenic.	☐	☐	☐	☐
12. Written or verbal notification is given to owners, contractors, or other personnel working in the area of arsenic work activities.	☐	☐	☐	☐
13. Storage or shipping containers are properly labeled.	☐	☐	☐	☐
HOUSEKEEPING (5.1.3)				
14. All surfaces are free of accumulation of arsenic.	☐	☐	☐	☐
15. Cleaning methods minimize airborne arsenic activity.	☐	☐	☐	☐
16. Where vacuuming is used, vacuums are used and emptied to minimize airborne arsenic.	☐	☐	☐	☐
17. A written housekeeping and maintenance plan is in place and maintained.	☐	☐	☐	☐
18. Compressed air is not used to remove arsenic from surfaces.	☐	☐	☐	☐
REGULATED AREAS (5.1.4)				
19. Areas that exceed the PEL have been designated as regulated areas.	☐	☐	☐	☐
20. Personnel meet medical and training requirements.	☐	☐	☐	☐
21 No eating, drinking, and/or smoking is allowed in the regulated areas.	☐	☐	☐	☐
22 Warning signs have been posted at all entrances to the regulated areas.	☐	☐	☐	☐
23. Shower facilities are installed and used with cleaning agents and towels, where feasible.	☐	☐	☐	☐
24. Hand washing facilities are provided for use by employees before eating, drinking, smoking, etc.	☐	☐	☐	☐
25. Eating facilities free of arsenic are provided for employees working in regulated areas.	☐	☐	☐	☐
26. Change areas are provided where EL ≥ PEL or where employees are subject to eye or skin irritation.	☐	☐	☐	☐
EXPOSURE ASSESSMENTS (5.2)				
27. Initial air monitoring is conducted over full shift for each job classification.	☐	☐	☐	☐
28. Air sampling is conducted every 6 months when exposure limit (EL) ≥ AL but < PEL.	☐	☐	☐	☐
29. Air sampling of employees is conducted quarterly when EL ≥ PEL.	☐	☐	☐	☐
30. Additional air monitoring has been collected when there are any changes in operation.	☐	☐	☐	☐
31. Employees have been informed of air monitoring results within 5 days after receipt of results.	☐	☐	☐	☐
32. Where PEL is exceeded, affected employees have been notified of results and control measures to be used to reduce exposure below the PEL.	☐	☐	☐	☐
CONTROL METHODS (5.3)				
ENGINEERING AND WORK PRACTICE CONTROLS (5.3.1)				
33. Engineering controls and work practices have been used to reduce exposures below the PEL.	☐	☐	☐	☐
34. When controls are unable to reduce exposures below the PEL, respiratory protection is used.	☐	☐	☐	☐
35. Employees do not eat, drink, smoke, chew tobacco/gum, or apply cosmetics in regulated areas.	☐	☐	☐	☐
RESPIRATORY PROTECTION (5.3.2)				
36. Respirators are used in areas where EL ≥ PEL.	☐	☐	☐	☐
37. Respirator cartridges are replaced at the end of shift or service life indicator, where available.	☐	☐	☐	☐
38. PAPRs are provided to employees who request such a respirator.	☐	☐	☐	☐

PERSONAL PROTECTIVE EQUIPMENT (5.3.3)

39. PPE is supplied at no cost to employees.	☐	☐	☐	☐
40. Employee exposed to arsenic tri-chloride wear impervious clothing.	☐	☐	☐	☐
41 Clean and dry protective clothing is provided weekly. Daily if EL ≥ 100 $\mu g/m^3$.	☐	☐	☐	☐
42. Protective clothing is repaired or replaced if found to be ineffective.	☐	☐	☐	☐
43. Contaminated protective clothing is removed from change areas at the end of the shift.	☐	☐	☐	☐
44. All clothing requiring laundering is packaged in sealed, labeled containers.	☐	☐	☐	☐
45. Personnel or vendors who launder contaminated clothing are formally informed of the hazards.	☐	☐	☐	☐
46. Employee are not allowed to leave workplace wearing clothing worn during work shift.	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Section 1. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ________________________________ Project Manager: ____________________________

CH2MHILL

HS&E Self-Assessment Checklist

This checklist shall be used by Navy CLEAN personnel and shall be completed by each crew entering the work area at the frequency of one per day or otherwise specified in the project's Health and Safety Plan/Field Safety Instruction (HSP/FSI). The checklist should be completed prior to entry and at the end of the day to document that appropriate checks have been completed.

This checklist is to be used at locations where the possibility exists that contact with biological hazards is possible.

Site Safety Coordinator (SSC) will request any CH2M HILL subcontractor to take necessary precautions in eliminating the exposure to biological hazards, but shall not direct the means and methods.

Project Name: ______________________________ Project No.: ______________
Location: ______________________________ PM: ______________________
Auditor: ____________________ Title: ____________________ Date: __________

- 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.

SECTION 1 – PRE-ENTRY

	Yes	No	N/A	N/O
SITE HAZARD EVALUATION				
1. Inform field members of hazards (types, symptoms)	☐	☐	☐	☐
2. Can work be completed without entering the work zone	☐	☐	☐	☐
3. Have controls been implemented where possible (clearing vegetation, spraying)	☐	☐	☐	☐
4. Has an inspection been made to identify nests, hives or areas where insects may concentrate	☐	☐	☐	☐
5. Will working at different time will reduce exposure	☐	☐	☐	☐
SENSATIVITIES				
6. Does any staff have existing reactions to stings or bites	☐	☐	☐	☐
7. If yes to #6, is special required and medication available on site (epi-pen)	☐	☐	☐	☐
8. Has anyone with an existing condition briefed other team members about symptoms and first aid which may be required	☐	☐	☐	☐
EMERGENCY RESPONSE				
9. Are first aid kits, along with tick removal kits, readily available to all staff	☐	☐	☐	☐
10. Does each member of the field staff have ability to communicate (phone, radios, and visual)	☐	☐	☐	☐
11. Are emergency contacts available (base emergency, local police, or local EMT	☐	☐	☐	☐
12. If working in remote areas, is transport readily available (less than 5 minutes)	☐	☐	☐	☐
13. Have you planned an emergency exit from the site in the event of a swarm	☐	☐	☐	☐

SECTION 2 - PPE	Yes	No	N/A	N/O
SELECTION OF PPE				
14. Will weather (heat, rain, ice) impact the safety of workers wearing protective suits	☐	☐	☐	☐
15. Will visibility be limited to unacceptable levels if a hood is worn	☐	☐	☐	☐
16. Will the use of equipment be difficult if a suit is worn	☐	☐	☐	☐
17. Will heavy vegetation be encountered that could rip or damage a suit	☐	☐	☐	☐
18. Will a Bug-Out suit or Tyvek suit be used by staff (if not, please give additional rationale in writing in Section 4)	☐	☐	☐	☐
TYPE OF PPE USED OTHER THAN BUG-OUT OR TYVEK SUIT				
19. Is staff wearing light-colored clothes	☐	☐	☐	☐
20. Is staff wearing long sleeve shirts	☐	☐	☐	☐
21. Are pant legs tucked into socks	☐	☐	☐	☐
22. Are shirts tucked into pants	☐	☐	☐	☐
23. Has tape been placed around sock/pant leg line and around waist	☐	☐	☐	☐
24. Have hand and wrist areas been sealed	☐	☐	☐	☐
25. Are hats being worn	☐	☐	☐	☐
26. Have clothes been pre treated with Permethrin	☐	☐	☐	☐
27. Has team member inspected coworker's suits or clothing to ensure no spaces exist for insects to penetrate	☐	☐	☐	☐

SECTION 3 – CHECKS AND DECONTAMINATION	Yes	No	N/A	N/O
DAILY CHECKS (TO BE COMPLETED DURING AND AT END OF DAY)				
28. Were tick/insect checks performed during the day (if not, please provide reason in Section 4)	☐	☐	☐	☐
29. Was one unclothed tick check completed	☐	☐	☐	☐
30. Were ticks found on the outerwear (if yes, please note the number in Section 4)	☐	☐	☐	☐
31. Were ticks found inside the Bug-Out, Tyvek, or personal clothing	☐	☐	☐	☐
32. Were suits turned inside out and inspected prior to putting away	☐	☐	☐	☐
33. Were showers taken by field staff immediately upon arrive from the field	☐	☐	☐	☐
34. Were clothing placed in a garbage bag and sealed to prevent any insects from spreading	☐	☐	☐	☐
35. If ticks were found embedding in skin, were they properly removed and saved	☐	☐	☐	☐
36. Have vehicles been inspected for ticks on a daily basis and before the vehicle is turned in	☐	☐	☐	☐
REPORTING				
37. If a tick was found on your skin, could you tell where it entered so that it could be addressed	☐	☐	☐	☐
38. If a tick was found embedded, did you contact the PM, complete a HITS form and contact the Occupational Physician at 1-866-893-2514	☐	☐	☐	☐
39. Did you contact field staff on the project to provide potential corrective measures	☐	☐	☐	☐
40. Did you follow the IM/RTW procedure to ensure you received the proper medical attention (if not, provide an explanation in Section 4)	☐	☐	☐	☐

SECTION 4

Complete this section for all items where further information was requested in the previous sections.

Item #	Rationale	Corrected (either next day or intended on future projects)

Auditor: _________________________________ Project Manager: ______________________________

HSE 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-204.

SECTION 1 - SAFE WORK PRACTICES (5.1)

	Yes	No	N/A	N/O
1. Personnel cleared during rig startup	☐	☐	☐	☐
2. Personnel clear while mast is being raised	☐	☐	☐	☐
3. Personnel clear of rotating parts	☐	☐	☐	☐
4. Personnel not positioned under hoisted loads	☐	☐	☐	☐
5. Loose clothing and jewelry removed	☐	☐	☐	☐
6. Smoking is prohibited around drilling operation	☐	☐	☐	☐
7. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
8. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐

SECTION 2 - SUPPORT FUNCTIONS (5.2)

AQUIFER DESIGNATIONS (5.2.1)

	Yes	No	N/A	N/O
9. Aquifer designations determined and BGEM consulted when required.	☐	☐	☐	☐

LOCATION OF UTILITIES (5.2.2)

	Yes	No	N/A	N/O
10. Location of underground utilities and structures identified	☐	☐	☐	☐
11. Power lines de-energized and grounded when safe distances cannot be maintained	☐	☐	☐	☐

SECTION 2 (Continued)

WASTE MANAGEMENT (5.2.3)	Yes	No	N/A	N/O
12. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
13. Wastes generated evaluated for proper disposal	☐	☐	☐	☐
14. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT ORDNANCE EXPLOSIVES OR UNEXPLODED ORDNANCE SITES (5.2.4)				
15. MEC plan prepared and approved	☐	☐	☐	☐
16. MEC avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
17. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
18. Personnel remain inside cleared areas	☐	☐	☐	☐

SECTION 3 - DRILLING SAFETY REQUIREMENTS (5.3)

GENERAL (5.3.1)				
19. Only authorized personnel operating drill rigs	☐	☐	☐	☐
20. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
21. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
22. Good housekeeping maintained on and around rig	☐	☐	☐	☐
SAFETY EQUIPMENT (5.3.2)				
23. Safety-toed shoes/boots, hardhats, safety glasses, gloves and hearing protection are worn	☐	☐	☐	☐
24. Drill rig equipped with fire extinguisher	☐	☐	☐	☐
25. Air monitoring instruments provided when required	☐	☐	☐	☐
26. PPE for protection from chemical hazards is worn if required				
DRILL RIG PLACEMENT (5.3.3)				
27. Location of underground utilities and structures identified	☐	☐	☐	☐
28. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
29. Drilling pad established, when necessary	☐	☐	☐	☐
30. Drill rig leveled and stabilized	☐	☐	☐	☐
31. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (5.3.4)				
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. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
32. Spotter used when backing rig in tight or confined areas or when low clearances exist	☐	☐	☐	☐
33. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
EMERGENCY – CONTACT WITH OVERHEAD OR UNDERGROUND ELECTRICAL LINES (5.3.5)				
34. Personnel understand emergency procedures in the event of contact with overhead or underground electrical lines	☐	☐	☐	☐
DRILL RIG OPERATION (5.3.6)				
35. Kill switch clearly identified and operational	☐	☐	☐	☐
36. All machine guards are in place	☐	☐	☐	☐
37. Rig ropes never wrapped around any part of the body	☐	☐	☐	☐
38. Pressurized lines and hoses secured to prevent whipping hazards	☐	☐	☐	☐
39. Drilling operation stopped during inclement weather	☐	☐	☐	☐
40. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
41. Rig gear boxes placed in neutral when operator not at controls	☐	☐	☐	☐
42. Operator shuts rig engine down prior to leaving the drill rig vicinity	☐	☐	☐	☐

DRILL RIG SITE CLOSURE (5.3.7)

43. Ground openings/holes filled or barricaded ☐ ☐ ☐ ☐
44. Equipment and tools properly stored ☐ ☐ ☐ ☐
45. All vehicles locked and keys removed ☐ ☐ ☐ ☐

DRILL RIG MAINTENANCE (5.3.8)

46. Rig properly maintained per drilling company's maintenance program ☐ ☐ ☐ ☐
47. Defective components repaired immediately ☐ ☐ ☐ ☐
48. Lockout/tagout procedures used prior to maintenance ☐ ☐ ☐ ☐
49. Cathead in clean, sound condition ☐ ☐ ☐ ☐
50. Drill rig ropes in clean, sound condition ☐ ☐ ☐ ☐
51. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater ☐ ☐ ☐ ☐
52. Rig in neutral and augers stopped rotating before cleaning ☐ ☐ ☐ ☐
53. Good housekeeping maintained on and around rig ☐ ☐ ☐ ☐

FORMS/PERMITS AND CHECKLISTS (7.0)

54. Driller license/certification obtained ☐ ☐ ☐ ☐
55. Well development/abandonment notifications and logs submitted and in project files ☐ ☐ ☐ ☐
56. Groundwater withdrawal permit obtained where required ☐ ☐ ☐ ☐
57. Dig permit obtained where required ☐ ☐ ☐ ☐

SECTION 4

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

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _________________________________ Project Manager: ___________________________________

CH2MHILL

HS&E Self-Assessment Checklist—CHAINSAW OPERATIONS

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 operating chainsaws, and/or (2) CH2M HILL is providing oversight of a subcontractor operating a chainsaw.

Safety Coordinators may consult with chainsaw subcontractors when completing this checklist, but shall not direct the means and methods of chainsaw operations nor direct the details of corrective actions. Chainsaw 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 chainsaw hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with chainsaw 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 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 HS-49.

SECTION 1

	Yes	No	N/A	N/O
SAFETY EQUIPMENT (2.3)				
1. Chainsaw equipped with spark arrestor and fully functioning chain brake	☐	☐	☐	☐
2. Chainsaw operator's manual readily available	☐	☐	☐	☐
3. Fully stocked first aid kit and multipurpose fire extinguisher available	☐	☐	☐	☐
4. Appropriate personal protective equipment available and worn	☐	☐	☐	☐
5. Clothing free of loose edges that could become entangled in the saw	☐	☐	☐	☐
PLANNING ACTIVITIES (2.5)				
6. Operators have read the chainsaw operator's manual	☐	☐	☐	☐
7. If aerial lifts to be used, aerial lift training completed	☐	☐	☐	☐
8. Daily safety briefing/meeting conducted with project personnel to discuss planned work	☐	☐	☐	☐
9. Immediate area surrounding operation cleared of obstructions	☐	☐	☐	☐

	Yes	No	N/A	N/O
10. Companion maintained within calling distance of the chainsaw operator	☐	☐	☐	☐

SECTION 1 (Continued)

	Yes	No	N/A	N/O
INSPECTION (3.1.1)				
11. Chain tension, sharpness, condition, and guide gap checked	☐	☐	☐	☐
12. Chainsaw components checked for physical damage	☐	☐	☐	☐
13. Chain does not rotate at idle with chain brake off	☐	☐	☐	☐
14. Chain brake and stop switch operating correctly	☐	☐	☐	☐
15. Throttle trigger can not be engaged until throttle trigger lock out pressed	☐	☐	☐	☐
STARTING THE ENGINE (3.1.2)				
16. Chainsaw operator’s manual consulted for proper starting procedures	☐	☐	☐	☐
17. Saw placed on level ground with guide bar and chain off the ground	☐	☐	☐	☐
18. Saw is not drop-started	☐	☐	☐	☐
SAFE OPERATION (3.1.3)				
19. Chainsaw handles kept dry, clean, and free of oil or fuel mixture	☐	☐	☐	☐
20. Chainsaws held firmly with both hands and used right-handed	☐	☐	☐	☐
21. Operator standing to the left of the saw out of the plane of the chain	☐	☐	☐	☐
22. Saw used between the waist and mid-chest level	☐	☐	☐	☐
23. Full throttle maintained while cutting	☐	☐	☐	☐
24. Operator aware of position of guide bar tip, does not contact tip with anything being cut	☐	☐	☐	☐
25. Bumper spikes maintained as close to the object as possible	☐	☐	☐	☐
26. Operator aware of what is in the saw’s downward path after the cut	☐	☐	☐	☐
27. No attempt to made to cut material that is larger than the guide bar of the saw	☐	☐	☐	☐
28. Cuts avoided that will cause chain to jam	☐	☐	☐	☐
29. Non-metallic wedges used to prevent compression cuts from jamming the blade	☐	☐	☐	☐
30. Bystanders and helpers kept at a safe distance from operation	☐	☐	☐	☐
31. Chainsaw not operated when fatigued	☐	☐	☐	☐
32. Fire extinguisher present when operating the chainsaw in forest or brushy areas	☐	☐	☐	☐
ELECTRICAL CHAINSAW PRECAUTIONS (3.1.3)				
33. Extension cords approved for outdoor use	☐	☐	☐	☐
34. Electrical cords equipped with third-wire grounding	☐	☐	☐	☐
35. Ground fault circuit interrupter (GFCI) used	☐	☐	☐	☐
36. Electrical cord positioned carefully to avoiding cutting with saw or trip hazard	☐	☐	☐	☐
37. Saw switched to the off position before completing electrical connections	☐	☐	☐	☐
38. Saw unplugged before making adjustments and when not in use	☐	☐	☐	☐
REFUELING THE ENGINE (3.1.4)				
39. Fuel mixed in accordance with the manufacturer's recommendations	☐	☐	☐	☐
40. Fuel stored and transported in an approved safety container	☐	☐	☐	☐
41. Engine shut off and allowed to cool before refueling	☐	☐	☐	☐
42. Fire extinguisher present during fueling and refueling	☐	☐	☐	☐
43. Area around refueling site free from combustible materials	☐	☐	☐	☐
44. Smoking around fueling or refueling operations prohibited	☐	☐	☐	☐
45. Funnel/flexible nozzle used to avoid spilling fuel on the engine	☐	☐	☐	☐
TRANSPORT AND STORAGE (3.1.5)				
46. Chainsaws carried with engine off and guide bar pointing to rear	☐	☐	☐	☐
47. Chain guard attached or placed in carrying case prior to transporting	☐	☐	☐	☐

	Yes	No	N/A	N/O
48. Fuel tank drained and spark plug disconnected for long-term storage	☐	☐	☐	☐
49. Chainsaw placed in scabbard or secured to platform prior to transporting in aerial lift	☐	☐	☐	☐

SECTION 1 (Continued)

	Yes	No	N/A	N/O
TOPPING UTILITY POLES (3.2.1)				
50. CH2M HILL only topping utility poles from an aerial lift platform	☐	☐	☐	☐
51. Aerial lifts operated safely (use aerial lift checklist in HS-41)	☐	☐	☐	☐
52. Maximum length of pole section cut at one time does not exceed 2’	☐	☐	☐	☐
53. Pole tested for stray voltage with foreign voltage detector prior to cutting	☐	☐	☐	☐
54. Wiring, staples, nails, and other hardware removed within 4” of cut path	☐	☐	☐	☐
55. Saw handled between chest and waist level	☐	☐	☐	☐
56. Personnel below pole safe distance from the fall area	☐	☐	☐	☐
57. Cutting stopped leaving approximately one half inch of pole uncut	☐	☐	☐	☐
58. Pole section removed manually by pulling cut section towards body	☐	☐	☐	☐
59. Cut pole sections lowered by rope or placed in aerial lift platform	☐	☐	☐	☐
60. Rough edges hammered over after last cut	☐	☐	☐	☐
TREE FELLING (3.2.2)				
61. CH2M HILL not felling trees beyond scope of SOP HS-49	☐	☐	☐	☐
62. Power company contacted prior to felling trees within two tree lengths of power lines	☐	☐	☐	☐
63. Underground services checked that could be damaged when tree strikes the ground	☐	☐	☐	☐
64. Danger zone created two tree lengths from public areas, public removed from danger zone	☐	☐	☐	☐
65. Personnel maintain a distance equal to two tree lengths of the tree being felled	☐	☐	☐	☐
66. Intended direction of fall determined	☐	☐	☐	☐
67. Suitable escape path determined and maintained clear	☐	☐	☐	☐
68. Equipment needed to prevent tree from sitting back on the saw determined and readily available	☐	☐	☐	☐
69. Undercut notch cut on side of the tree in the direction of the fall line	☐	☐	☐	☐
70. Back cut started 1-2” inches above the undercut	☐	☐	☐	☐
71. As tree starts to fall, saw shut off and operator steps into the escape path	☐	☐	☐	☐
LIMBING STANDING TREES (3.2.3)				
72. CH2M HILL not operating chainsaws where overhead electrical power lines may be contacted	☐	☐	☐	☐
73. Only subcontractors with special training permitted to work around electrical power lines	☐	☐	☐	☐
74. Branches/limbs not cut above shoulder height	☐	☐	☐	☐
75. If limbing from a ladder, ladder secured in position and operator independently secured	☐	☐	☐	☐
76. Chainsaws not used from rope and harness unless operator has received specific training	☐	☐	☐	☐
LIMBING FALLEN TREES (3.2.4)				
77. No dead branches/other debris hanging above work that may fall	☐	☐	☐	☐
78. Personnel do not attempt to manually pull over elevated trees, mechanical equipment used	☐	☐	☐	☐
79. Springpoles cut safely, avoiding springback	☐	☐	☐	☐
80. Small-size brush and saplings cut with hand saws or other cutting tools	☐	☐	☐	☐
81. Operator standing uphill of tree unless secured to prevent rolling/sliding downhill	☐	☐	☐	☐
82. Cuts made with operator standing on the opposite side of the tree	☐	☐	☐	☐
83. Operator keeping sight of saw tip, avoiding kickback	☐	☐	☐	☐
84. Debris removed periodically to maintain clear vision and movement around tree	☐	☐	☐	☐
BUCKING TREES (3.2.5)				
85. Operator standing uphill of tree unless secured to prevent rolling/sliding downhill	☐	☐	☐	☐
86. Working from small end to larger to improve stability	☐	☐	☐	☐

87. If tree on level ground, cutting from upper side and avoiding running chain into ground	☐	☐	☐	☐
88. If tree supported at one end, cutting from lower side one-third, then upper side	☐	☐	☐	☐
89. If tree supported at both ends, cutting from upper side one-third, then lower side	☐	☐	☐	☐

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/Taken	Date Corrected

Auditor: ______________________________ Project Manager: ________________________________

CH2MHILL

H&S Self-Assessment Checklist - FORKLIFTS

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 potentially exposed to hazards associated with forklift operations, 2) CH2M HILL employees are operating forklifts, and/or 3) CH2M HILL provides oversight of a subcontractor operating forklifts.

SC may consult with subcontractors using forklifts when completing this checklist, but shall not direct the means and methods of forklift operations nor direct the details of corrective actions. Subcontractors using forklifts 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 forklift hazards (Complete Section 1).
☐ Evaluate CH2M HILL employees operating forklifts (Complete entire checklist).
☐ Evaluate a CH2M HILL subcontractor's compliance with forklift 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 HS-48.

SAFE WORK PRACTICES (5.1) **SECTION 1**	**Yes**	**No**	**N/A**	**N/O**
1. Personnel maintaining safe distance from operating forklifts.	☐	☐	☐	☐
2. Positioning personnel in proximity to operating forklifts is avoided.	☐	☐	☐	☐
3. Personnel wearing high-visibility vests when close to operating forklifts.	☐	☐	☐	☐
4. Personnel approach operating forklifts safely.	☐	☐	☐	☐
5. Personnel only riding in seats equipped with seat belts.	☐	☐	☐	☐
6. Personnel not lifted or lowered by forklift unless approved for such use.	☐	☐	☐	☐
7. Personnel not positioned under elevated loads or forks.	☐	☐	☐	☐
8. Personnel do not place body between mast uprights or outside running lines during operation.	☐	☐	☐	☐
9. Personnel do not touch or approach forklift that has become electrically energized.	☐	☐	☐	☐

FORKLIFT SAFETY REQUIREMENTS SECTION 2	Yes	No	N/A	N/O
PRIOR TO OPERATING FORKLIFT (5.2.1)				
10. Only certified personnel operating forklifts.	☐	☐	☐	☐
11. Daily safety briefing/meeting conducted with forklift operators.	☐	☐	☐	☐
12. Daily inspection of forklift conducted and documented.	☐	☐	☐	☐
13. Rated capacity of forklift visible to operator.	☐	☐	☐	☐
14. Modifications and attachments used approved by forklift manufacturer.	☐	☐	☐	☐
15. High-lift forklifts have load backrest and overhead guard.	☐	☐	☐	☐
16. Seat belts are provided and used.	☐	☐	☐	☐
17. Backup alarm or spotter used when backing forklift.	☐	☐	☐	☐
18. Operational horn provided and used as necessary.	☐	☐	☐	☐
19. Braking system capable of stopping capacity load.	☐	☐	☐	☐
20. Forklifts equipped with lights for low-light operations.	☐	☐	☐	☐
21. Carbon monoxide concentrations below PEL (50 ppm).	☐	☐	☐	☐
22. At least one fire extinguisher available at the forklift operating area.	☐	☐	☐	☐
DESIGNATIONS AND LOCATIONS (5.2.2)				
23. Atmosphere/locations classified as hazardous or non-hazardous.	☐	☐	☐	☐
24. Only properly designated forklifts used in hazardous locations.	☐	☐	☐	☐
FORKLIFT LOADING/UNLOADING (5.2.3)				
25. Operator handles only loads within rated capacity, adjusts for long or tall loads.	☐	☐	☐	☐
26. Loads are stabilized before forklift travel.	☐	☐	☐	☐
27. Operator using proper tilt to stabilize load, uses caution when tilting elevated loads.	☐	☐	☐	☐
28. When two forklifts lift a load in unison, operators stay in close communication.	☐	☐	☐	☐
29. Trucks, trailers, railroad cars secured from movement before entering with forklift.	☐	☐	☐	☐
30. Dockplates/bridgeplates secured before use; capacity not exceeded.	☐	☐	☐	☐
31. Truck, trailer, railroad car flooring checked for weakness before forklift boarding.	☐	☐	☐	☐
32. Personnel platforms secured to forklift and shut off means provided on platform.	☐	☐	☐	☐
FORKLIFT TRAVEL (5.2.4)				
33. Forklift operated on safe roadways and grades.	☐	☐	☐	☐
34. Grades ascended/descended properly.	☐	☐	☐	☐
35. Forklift operated at safe speed, kept under control at all times	☐	☐	☐	☐
36. Operators slow down and use horn at areas with obstructed vision.	☐	☐	☐	☐
37. Forklifts operating in reverse when load obstructs vision.	☐	☐	☐	☐
38. Operator keeping clear view of path of travel.	☐	☐	☐	☐
39. Forklifts do not pass other stopped vehicles at areas with obstructed vision.	☐	☐	☐	☐
40. Operators maintain safe distance from edge of ramps and platforms.	☐	☐	☐	☐
41. Overhead clearance maintained from installations.	☐	☐	☐	☐
42. Forklifts not parked within 8 feet of center of railroad tracks. Tracks crossed diagonally.	☐	☐	☐	☐
43. Forklift parked correctly when operator is dismounted.	☐	☐	☐	☐
FORKLIFT MAINTENANCE (5.2.5)				
44. Forklifts with unsafe conditions removed from service and tagged as such to prevent use.	☐	☐	☐	☐
45. Forklifts repaired in designated, non-hazardous locations by authorized personnel.	☐	☐	☐	☐
46. Battery disconnected when repairing electrical systems.	☐	☐	☐	☐
47. Additions or omissions of parts not performed without manufacturer’s approval.	☐	☐	☐	☐
48. Good housekeeping maintained on and around forklift.	☐	☐	☐	☐
49. Water mufflers checked daily, kept at 75% full.	☐	☐	☐	☐
50. Forklifts removed from service if sparks, flames, or elevated operating temperatures occur.	☐	☐	☐	☐
51. Suspended forklifts or components are supported prior to work under or between.	☐	☐	☐	☐
52. Fueling/battery charging conducted in designated, well-ventilated area.	☐	☐	☐	☐
53. Fueling/battery charging areas properly equipped for task.	☐	☐	☐	☐
54. No smoking in fueling/battery charging areas.	☐	☐	☐	☐

55. Spillage of fuel properly cleaned up before starting forklift.	☐	☐	☐	☐

<u>SECTION 3</u>

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

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 potentially exposed to the hazards of earthmoving equipment operations, 2) CH2M HILL employees are operating earthmoving equipment, and/or 3) CH2M HILL provides oversight of a subcontractor operating earthmoving equipment.

The CH2M HILL Safety Coordinator may consult with subcontractors operating earthmoving equipment when completing this checklist, but shall not direct the means and methods of equipment operations nor direct the details of corrective actions. Earthmoving equipment 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 earthmoving equipment hazards (complete Section 1).
☐ Evaluate CH2M HILL employees operating earthmoving equipment (complete entire checklist).
☐ Evaluate CH2M HILL subcontractor's compliance with earthmoving equipment 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 earthmoving equipment 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-306.

SAFE WORK PRACTICES (5.1) — SECTION 1	Yes	No	N/A	N/O
1. Personnel maintaining safe distance from operating equipment	☐	☐	☐	☐
2. Positioning personnel in close proximity to operating equipment is avoided	☐	☐	☐	☐
3. Personnel wearing high-visibility and/or reflective vests when close to operating equipment	☐	☐	☐	☐
4. Personnel approach operating equipment safely	☐	☐	☐	☐
5. Personnel riding only in seats of equipment cab and using seat belts	☐	☐	☐	☐
6. Personnel not positioned under elevated portions of equipment	☐	☐	☐	☐
7. Personnel not positioned under hoisted loads	☐	☐	☐	☐
8. Personnel not hoisted by equipment	☐	☐	☐	☐
9. Personnel do not to approach equipment that has become electrically energized	☐	☐	☐	☐
10. Personnel wearing appropriate PPE, per HSP/FSI	☐	☐	☐	☐

EQUIPMENT SAFETY REQUIREMENTS SECTION 2	Yes	No	N/A	N/O
PRIOR TO OPERATING EQUIPMENT (5.2.1)				
11. Only qualified and authorized personnel operating equipment	☐	☐	☐	☐
12. Daily safety briefing/meeting conducted with equipment operators	☐	☐	☐	☐
13. Daily inspection of equipment conducted and documented	☐	☐	☐	☐
14. Modifications and attachments used approved by equipment manufacturer	☐	☐	☐	☐
15. Backup alarm or spotter used when backing equipment	☐	☐	☐	☐
16. Operational horn provided on bi-directional equipment	☐	☐	☐	☐
17. Seat belts are provided and used	☐	☐	☐	☐
18. Rollover protective structures (ROPS) provided	☐	☐	☐	☐
19. Braking system capable of stopping full payload	☐	☐	☐	☐
20. Headlights and taillights operable when additional light required	☐	☐	☐	☐
21. Brake lights in operable condition	☐	☐	☐	☐
22. Cab glass provides no visible distortion to the operator	☐	☐	☐	☐
23. All machine guards are in place	☐	☐	☐	☐
24. Hauling equipment (dump trucks) provided with cab shield or canopy	☐	☐	☐	☐
25. Dump truck beds provided with positive means of support during maintenance or inspection	☐	☐	☐	☐
26. Dump truck operating levers provided with latch to prevent accidental dumping	☐	☐	☐	☐
27. Air monitoring conducted per HSP/FSI for hazardous atmospheres	☐	☐	☐	☐
EQUIPMENT PLACEMENT (5.2.2)				
28. Equipment position on firm/level surface, outriggers used	☐	☐	☐	☐
29. Location of underground utilities identified	☐	☐	☐	☐
30. Safe clearance distance maintained while working under overhead power lines	☐	☐	☐	☐
31. Safe distance is maintained while traveling under power lines	☐	☐	☐	☐
32. Warning system used to remind operator of excavation edge	☐	☐	☐	☐
33. Unattended equipment visibly marked at night	☐	☐	☐	☐
34. Tools lowered/parking brake set when not in use, wheels chocked when parked on incline	☐	☐	☐	☐
EQUIPMENT OPERATION (5.2.3)				
35. Equipment operated on safe roadways and grades	☐	☐	☐	☐
36. Equipment operated at safe speed	☐	☐	☐	☐
37. Operators maintain unobstructed view of travel path	☐	☐	☐	☐
38. Equipment not operated during inclement weather, lightning storms	☐	☐	☐	☐
39. Equipment started and moved safely	☐	☐	☐	☐
40. Operators keep body parts inside cab during operation	☐	☐	☐	☐
41. Vehicle occupants in safe position while loading/unloading	☐	☐	☐	☐
42. Signal person visible to operator when required	☐	☐	☐	☐
43. Equipment used for hoisting done according to equipment manufacturer specifications	☐	☐	☐	☐
44. Lifting and hauling capacities are not exceeded	☐	☐	☐	☐
EQUIPMENT MAINTENANCE (5.2.4)				
45. Defective components repaired immediately	☐	☐	☐	☐
46. Suspended equipment or attachments supported prior to work under or between	☐	☐	☐	☐
47. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
48. Tires on split rims removed using safety tire rack or cage	☐	☐	☐	☐
49. Good housekeeping maintained on and around equipment	☐	☐	☐	

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.	☐	☐	☐	☐

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.	☐	☐	☐	☐
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)	Yes	No	N/A	N/O
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: ___________________________________

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	☐	☐	☐	☐

HS&E Self-Assessment Checklist—FALL PROTECTION

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 required to use fall protection (complete Section 1), (2) CH2M HILL employees are designing or installing fall protection systems (complete Section 2); and/or (3) CH2M HILL provides oversight of a subcontractor whose personnel design or install fall protection systems or are required to use fall protection (complete entire checklist).

SC may consult with subcontractors when completing this checklist, but shall not direct the means and methods of fall protection 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.

Project Name: ______________________________ Project No.: ______________

Location: ______________________________ PM: ______________________

Auditor: ____________________ Title: ____________________ Date: __________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to fall hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with fall protection 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-308.

FALL PROTECTION USE (3.2) — **SECTION 1**	**Yes**	**No**	**N/A**	**N/O**
1. CH2M HILL employees have completed initial fall protection training	☐	☐	☐	☐
2. Project Fall Protection Evaluation Form is completed	☐	☐	☐	☐
3. CH2M HILL employees have complete project-specific fall protection training	☐	☐	☐	☐
4. Personnel aware of and follow requirements established by competent person	☐	☐	☐	☐
5. Personnel only using systems for which they have received training	☐	☐	☐	☐
6. Fall protection equipment used only for fall protection and not to hoist materials	☐	☐	☐	☐
7. Horizontal lifelines used under supervision of qualified person	☐	☐	☐	☐
8. When vertical lifelines are used, each employee attached to a separate lifeline	☐	☐	☐	☐
9. Personnel remaining within guardrails, when provided	☐	☐	☐	☐
10. Personnel do not stand on objects or ladders on top platforms protected by guardrails	☐	☐	☐	☐
11. Personal fall arrest systems (PFAS) inspected prior to each use for defects	☐	☐	☐	☐
12. PFAS rigged such that personnel can neither free-fall more than 6', nor contact any lower level	☐	☐	☐	☐
13. PFAS anchorages capable of supporting 5,000 pounds	☐	☐	☐	☐
14. PFAS not be attached to guardrail systems or hoists	☐	☐	☐	☐
15. PFAS components subjected to impact loading immediately removed from service	☐	☐	☐	☐

CONSTRUCTION & INSTALL SECTION 2	Yes	No	N/A	N/O
GUARDRAILS (3.3.1)				
16. Top rails positioned 39”-45” above the walking/working level	☐	☐	☐	☐
17. Midrails, screen, or other barrier between the top rail and the walking/working surface	☐	☐	☐	☐
18. Wood construction: 2”x4” top rails, 1”x6” midrails, and 2”x4” posts spaced every 8’	☐	☐	☐	☐
19. Pipe construction: 1-½” nominal diameter with posts spaced every 8’	☐	☐	☐	☐
20. Structural steel construction: 2”x2”x3/8” angles with posts spaced every 8’	☐	☐	☐	☐
21. Other construction: pass a 200 lb. load test, no deflection < 39”	☐	☐	☐	☐
22. Natural or synthetic rope top rails/midrails inspected frequently & pass 200 lb. load test	☐	☐	☐	☐
23. Wire rope top rails/midrails ≥ ¼” nominal diameter and flagged every 6’	☐	☐	☐	☐
24. Points of access (ladderways) provided with gate or offset	☐	☐	☐	☐
SAFETY NETS (3.3.2)				
25. Nets installed as close as practicable under the walking/working surface, < 30’	☐	☐	☐	☐
26. Potential fall area from bridge surfaces to net unobstructed	☐	☐	☐	☐
27. Nets extend outward from the work surface based on the vertical fall distance	☐	☐	☐	☐
28. Nets pass drop test or competent person certifies nets are in compliance	☐	☐	☐	☐
29. Nets installed with sufficient clearance underneath to prevent contact with the surface	☐	☐	☐	☐
30. Nets inspected at least once a week and after any occurrence that could affect its integrity	☐	☐	☐	☐
31. Objects in net removed as soon as possible, at least before the next work shift	☐	☐	☐	☐
32. Mesh openings ≤ 6” in length on any side	☐	☐	☐	☐
33. Border ropes have a minimum breaking strength of 5,000 pounds	☐	☐	☐	☐
34. Safety net panel connections as strong as integral net components and spaced ≤ 6” apart	☐	☐	☐	☐
PERSONAL FALL ARREST SYSTEMS (3.3.3)				
35. PFAS components meet or exceed OSHA strength criteria	☐	☐	☐	☐
36. PFAS rigged such that personnel can neither free-fall more than 6’, nor contact any lower level	☐	☐	☐	☐
37. Body harness back dee-ring used as attachment point	☐	☐	☐	☐
38. Only locking type snaphooks are used	☐	☐	☐	☐
39. Horizontal lifelines used under supervision of qualified person with safety factor of ≥ 2	☐	☐	☐	☐
40. When vertical lifelines are used, each employee attached to a separate lifeline	☐	☐	☐	☐
41. PFAS anchorages independent of anchorages used to support or suspend platforms	☐	☐	☐	☐
42. Anchorages capable of supporting ≥ 5,000 lbs. per person or used under supervision of qualified person with safety factor of ≥ 2	☐	☐	☐	☐
43. Method of rescue provided in the event of a fall	☐	☐	☐	☐
POSITIONING DEVICES (3.3.4)				
44. Components meet or exceed OSHA PFAS construction and strength criteria	☐	☐	☐	☐
45. Components inspected prior to each use and defective components removed from service	☐	☐	☐	☐
46. Positioning devices rigged such that personnel cannot free-fall more than 2’	☐	☐	☐	☐
47. Anchorages capable of supporting ≥ 2 times potential impact load of fall or 3,000 pounds	☐	☐	☐	☐
WARNING LINES (3.4.5)				
48. Warning lines 34”-39” from the walking/working surface	☐	☐	☐	☐
49. Warning lines flagged at ≤ 6’ intervals with high-visibility material	☐	☐	☐	☐
50. Warning lines attached at stanchions capable of resisting 16 lb. force without tipping	☐	☐	☐	☐
51. Warning lines erected ≥ 6’ from each roof edge	☐	☐	☐	☐
52. Warning lines erected ≥ 10’ from roof edge perpendicular to mechanical equipment travel	☐	☐	☐	☐
53. Warning line placed across the access points when not in use	☐	☐	☐	☐
54. Only personnel performing roof work between a roof edge and a warning line	☐	☐	☐	☐

SECTION 2 (continued)	Yes	No	N/A	N/O
CONTROLLED ACCESS ZONE (3.3.6)				
55. Control lines enclose controlled access zones	☐	☐	☐	☐
56. Only personnel engaged in related work permitted in the controlled access zone	☐	☐	☐	☐
57. Control lines 30”-45” from the walking/working surface	☐	☐	☐	☐
58. Control lines flagged at ≤ 6’ intervals with high-visibility material	☐	☐	☐	☐
59. Overhand bricklaying control lines positioned 10’-15’ from working edge	☐	☐	☐	☐
60. Leading edge control lines positioned 6’-25’ from leading edge	☐	☐	☐	☐
61. Precast concrete control lines positioned 6’-60’ or half the length of the erected member	☐	☐	☐	☐
SAFETY MONITORING SYSTEM (3.3.7)				
62. Safety monitor designated to observe and warn personnel	☐	☐	☐	☐
63. Safety monitor not distracted from the monitoring function	☐	☐	☐	☐
64. Safety monitor on the same working surface within sight and voice communication	☐	☐	☐	☐
65. Only personnel necessary for work in safety monitoring zone	☐	☐	☐	☐
66. Personnel adhere to the safety monitor’s instructions	☐	☐	☐	☐
FALL PROTECTION PLAN (3.3.8)				
67. Plan prepared by qualified person and specifically for site work being performed	☐	☐	☐	☐
68. Plan maintained current with changes approved by a qualified person	☐	☐	☐	☐
69. Plan maintained at the job site and implemented by competent person	☐	☐	☐	☐
70. Plan documents why fall protection systems are infeasible or would create a greater hazard	☐	☐	☐	☐
71. Plan discusses measures taken to reduce or eliminate the fall hazards	☐	☐	☐	☐
72. Plan discusses when scaffolds, ladders, or vehicle mounted work platforms shall be used	☐	☐	☐	☐
73. Locations covered by plan identified and classified as controlled access zones	☐	☐	☐	☐
74. Entry into controlled access zone limited to personnel designated in plan	☐	☐	☐	☐
75. Safety monitoring system used when no other alternative measure implemented	☐	☐	☐	☐
COVERS (3.3.9)				
76. Covers capable of supporting 2x the maximum weight imposed on the cover at any one time	☐	☐	☐	☐
77. Covers secured to prevent accidental displacement	☐	☐	☐	☐
78. Covers color coded or marked HOLE or COVER	☐	☐	☐	☐
FALLING OBJECT PROTECTION (3.3.10)				
79. Personnel exposed to falling objects wearing hard hats	☐	☐	☐	☐
80. Objects on elevated surfaces positioned away from surface edge	☐	☐	☐	☐
81. Toeboards, screens, guardrails, or canopies used or area barricaded below	☐	☐	☐	☐
82. Toeboards, when used, erected along the edge of the overhead walking/working surface	☐	☐	☐	☐
83. Toeboards 3-½” high, ≤ ¼” clearance above the surface, and no openings > 1”	☐	☐	☐	☐
84. Screening/paneling provided where equipment or materials are piled above toeboards	☐	☐	☐	☐
85. Guardrails, when used, no openings small enough to prevent passage of falling objects	☐	☐	☐	☐
86. Overhand bricklaying masonry/mortar not stored within 4’ of working edge	☐	☐	☐	☐
87. Excess overhand bricklaying mortar, masonry units, and other debris kept clear	☐	☐	☐	☐
88. Roofing materials not stored within 6’ of a roof edge, unless guardrails are provided	☐	☐	☐	☐
89. Roofing materials that are near roof edge are stable and self-supporting	☐	☐	☐	☐
90. Canopies, when used, strong enough to prevent collapse and penetration by falling objects	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist—FALL PROTECTION

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.	☐	☐	☐	☐

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	☐	☐	☐	☐

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 exposed to lead, or are required to perform oversight of a subcontractor whose personnel are exposed to lead.

CH2M HILL staff shall not direct the means and methods of subcontractor lead activities nor direct the details of appropriate 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:
☐ Evaluate CH2M HILL compliance with its Lead program (SOP HSE-508)
☐ Evaluate a CH2M HILL subcontractor's compliance with its Lead program
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

SECTION 1

	Yes	No	N/A	N/O
PERSONNEL SAFE WORK PRACTICES (5.1)				
COMPLIANCE PROGRAM (5.3)				
1. Where EL ≥ PEL, a written compliance program is implemented prior to commencing work.	☐	☐	☐	☐
2. The compliance program is based on the most recent air monitoring/sampling results.	☐	☐	☐	☐
3. The compliance program is updated for new exposure monitoring data or annually.	☐	☐	☐	☐
4. Written compliance program is available to all affected employees.	☐	☐	☐	☐
5. Waste generated must be determined if considered hazardous waste.	☐	☐	☐	☐
EMPLOYEE INFORMATION (5.2.1)				
6. CH2M HILL personnel have completed the Lead Training Module	☐	☐	☐	☐
7. Training on the Fact Sheet, HSP/FSI and OSHA standard has been met.	☐	☐	☐	☐
8. The selection of the appropriate respirator is based on the airborne lead concentration	☐	☐	☐	☐
9. Personnel working near lead-contaminated soil or material shall use wet methods and work practices to control dust; wear disposable coveralls and exercise personal hygiene practices	☐	☐	☐	☐
10. Contact lenses are not worn when working with lead	☐	☐	☐	☐

	Yes	No	N/A	N/O
REGULATED AREAS (5.4)				
11. Written or verbal notification to owners, contractors or other personnel working in the area of lead work activities	☐	☐	☐	☐
12. Areas that exceed the PEL have been designated as regulated areas.	☐	☐	☐	☐
13. Personnel meet medical and training requirements.	☐	☐	☐	☐
14. No eating, drink, and/or smoking are allowed in the regulated areas.	☐	☐	☐	☐
15. Warning signs have been posted at all entrances to the regulated areas.	☐	☐	☐	☐
16. Shower facilities installed and used with cleaning agents and towels, where feasible.	☐	☐	☐	☐
17. Hand washing facilities provided for use by employees prior to eating, drinking, smoking, etc.	☐	☐	☐	☐
18. Eating facilities free of lead provided for employees working in regulated areas.	☐	☐	☐	☐
19. Change areas provided where EL ≥ PEL or where employees are subject to eye or skin irritation.	☐	☐	☐	☐
HOUSEKEEPING (5.5)				
20. All surfaces are free of accumulation of lead.	☐	☐	☐	☐
21 Cleaning methods minimize airborne lead activity.	☐	☐	☐	☐
22. Where vacuuming is used, vacuums are used and emptied as to minimize airborne lead.	☐	☐	☐	☐
23. Compressed air not used to remove lead from surfaces.	☐	☐	☐	☐
EXPOSURE ASSESSMENTS (5.1)				
24. Initial air monitoring conducted over full shift for each job classification.	☐	☐	☐	☐
25. Air sampling conducted every six months when exposure limit (EL) ≥ AL but < PEL.	☐	☐	☐	☐
26. Air sampling of employees conducted quarterly when EL ≥ PEL.	☐	☐	☐	☐
27. Additional air monitoring has been collected when there are any changes in operation.	☐	☐	☐	☐
28. Employees have been informed of air monitoring results within 5 days after receipt of results.	☐	☐	☐	☐
29. Where PEL is exceeded, affected employees have been notified of results and control measures to be utilized to reduce exposure below the PEL.	☐	☐	☐	☐
CONTROL METHODS (5.2)				
ENGINEERING AND WORK PRACTICE CONTROLS (5.2.1)				
30. Engineering controls and work practices have been utilized to reduce exposures below the PEL.	☐	☐	☐	☐
31. Mechanical ventilation performance evaluated when used to control exposure.	☐	☐	☐	☐
32. Job rotation schedule established, when using administrative controls.	☐	☐	☐	☐
33. When controls are unable to reduce exposures below the PEL, respiratory protection is utilized	☐	☐	☐	☐
RESPIRATORY PROTECTION (5.2.2)				
34. Respirators are used in areas where EL ≥ PEL.	☐	☐	☐	☐
35. Respirator filters are replaced at the beginning of shift.	☐	☐	☐	☐
36. PAPRs are provided to employees who request such a respirator.	☐	☐	☐	☐

		Yes	No	N/A	N/O
PERSONAL PROTECTIVE EQUIPMENT (5.2.3)					
37.	PPE is supplied at no cost to employees	☐	☐	☐	☐
38.	Clean and dry protective clothing is provided weekly, daily if EL ≥ 200 $\mu g/m^3$	☐	☐	☐	☐
39.	Protective clothing is repair or replaced if found to be ineffective	☐	☐	☐	☐
40.	PPE is not blown, shook or other methods used to clean...	☐	☐	☐	☐
41.	Employee not allowed to leave workplace wearing clothing worn during work shift.	☐	☐	☐	☐
42.	Contaminated protective clothing is removed from change areas at the end of the shift.	☐	☐	☐	☐
43.	All clothing requiring laundering is packaged in sealed, labeled containers.	☐	☐	☐	☐
44.	Personnel or vendors who launder contaminated clothing are formally informed of the hazards.	☐	☐	☐	☐

SECTION 2

Complete this section for all items checked “No” in Section 1. Deficient items be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ________________________________ Project Manager: ____________________________

HS&E Self-Assessment Checklist – LOCKOUT/TAGOUT

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 when: 1) CH2M HILL staff are exposed to lockout/tagout hazards (complete Section 1), 2) CH2M HILL staff are self-performing lockout/tagout activities (completed Section 2), or 3) CH2M HILL provides oversight of subcontractor personnel who are performing lockout/tagout activities (complete Sections 1 and 2).

Safety Coordinator may consult with subcontractors when completing this checklist, but shall not direct the means and methods of lockout/tagout 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.

Project Name: ____ Project No.: ____________________

Location: ____ PM: ______________________________

Auditor: ________________________________ Title: _____________________________ Date: ___________

This specific checklist has been completed to:

☐ Evaluate CH2M HILL affected employee exposure to equipment during lockout/tagout
☐ Evaluate CH2M HILL authorized employee exposure to equipment requiring lockout/tagout
☐ Evaluate a CH2M HILL subcontractor's compliance with lockout/tagout 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-33.

SECTION 1

SAFE WORK PRACTICES (5.4)

	Yes	No	N/A	N/O
1. Only trained and authorized personnel are performing lockout/tagout activities	☐	☐	☐	☐
2. All affected employees notified prior to lockout/tagout activities	☐	☐	☐	☐
3. Equipment has been shutdown using normal operating controls	☐	☐	☐	☐
4. Employees do not attempt to start, energize or use equipment that is locked out or tagged	☐	☐	☐	☐
5. Employees do not remove locks or tags placed on equipment by other personnel	☐	☐	☐	☐
6. Affected employees are notified after lockout/tagout is completed	☐	☐	☐	☐
7. Employees verify that all safe guards have been replaced prior to equipment start-up	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (5.5.1)				
8. Only trained and authorized personnel are performing lockout/tagout activities	☐	☐	☐	☐
9. Daily safety briefing/meeting conducted with affected and authorized employees	☐	☐	☐	☐
10. Employees made aware of any equipment-specific lockout/tagout procedures	☐	☐	☐	☐
11. Authorized employees provided with lockout devices, locks, tags and other isolation devices	☐	☐	☐	☐
12. New or modified equipment designed to accept lockout devices	☐	☐	☐	☐
EQUIPMENT-SPECIFIC LOCKOUT/TAGOUT PROCEDURES (5.5.2)				
13. LOTO procedures available when required to be documented	☐	☐	☐	☐
14. Equipment-specific LOTO procedures developed when not available from the facility	☐	☐	☐	☐
15. Affected employees notified that equipment will be shut down for LOTO	☐	☐	☐	☐
16. Energy sources, hazards, and control measures determined	☐	☐	☐	☐
17. Orderly shutdown of equipment is conducted that does not increase hazards	☐	☐	☐	☐
18. Energy isolating devices operated to isolate energy sources	☐	☐	☐	☐
19. Authorized employees apply personal lockout devices and tags to energy isolating device	☐	☐	☐	☐
20. Lockout devices are applied to secure equipment in the “off” position	☐	☐	☐	☐
21. Lockout tags applied to clearly indicate that operating the equipment is prohibited	☐	☐	☐	☐
22. Tags are located as close to or at the energy isolating device	☐	☐	☐	☐
23. All hazardous stored or residual energy is relieved, disconnected or restrained.	☐	☐	☐	☐
24. Isolation of energy sources has been verified (tested) prior to of work on equipment	☐	☐	☐	☐
25. Lockout tags are used alone only where lockout devices cannot be applied	☐	☐	☐	☐
LOCKOUT DEVICES AND TAGS (5.5.4)				
26. Lockout devices and tags only used to isolate energy sources	☐	☐	☐	☐
27. Lockout devices and tags are standardized by color, shape, size, print, and format	☐	☐	☐	☐
28. Lockout devices and tags indicate identity of employee applying the devices	☐	☐	☐	☐
29. Lockout devices and tags capable of withstanding anticipated environmental conditions of use	☐	☐	☐	☐
30. Lockout devices are substantial enough to prevent removal without the use of excessive force	☐	☐	☐	☐
31. Tags and their means of attachment are substantial enough to prevent inadvertent removal	☐	☐	☐	☐
32. Tags are legible and understandable by all employees	☐	☐	☐	☐
33. Tags warn against hazardous conditions if equipment is energized	☐	☐	☐	☐
RELEASING LOTO CONTROL (5.5.5)				
34. Work area inspected prior to removing LOTO devices and reenergization	☐	☐	☐	☐
35. LOTO devices only removed by authorized employees who applied the device	☐	☐	☐	☐
36. If employee not available to remove LOTO devices, steps in Section 4.2.4 of SOP followed	☐	☐	☐	☐
37. All affected employees notified prior to starting equipment previously locked or tagged out	☐	☐	☐	☐
GROUP LOTO (5.5.6)				
38. Group LOTO procedures followed when more than one employees is to work on equipment	☐	☐	☐	☐
39. Primary authorized person assigned to coordinate LOTO process	☐	☐	☐	☐
40. Normal steps for initiating LOTO control completed as above	☐	☐	☐	☐
41. Primary authorized person applies own lockout device and tag	☐	☐	☐	☐
42. Each authorized person applies own lockout device and tag	☐	☐	☐	☐
43. Primary authorized person removes LOTO devices after all other LOTO devices are removed	☐	☐	☐	☐
SPECIAL CONDITIONS (5.5.7)				
44. Shift or personnel changes coordinated to ensure LOTO protection is always provided	☐	☐	☐	☐
45. Procedures followed when LOTO devices are temporarily removed to test or reposition	☐	☐	☐	☐

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: _____________________________________

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).	o	o	o	o
2. Equipment or supplies are being delivered as close as possible to their use point.	o	o	o	o
3. Heavy equipment or supplies are being stored off the ground and no lower than knee height.	o	o	o	o
4. Adequate space has been provided to access and lift equipment or supplies without reaching or twisting.	o	o	o	o

Safe Work Practices (5.1)	**Yes**	**No**	**N/A**	**N/O**
5. Tasks or activities have been modified to reduce or minimize manual lifting.	o	o	o	o
6. All employees performing manual lifting have received training on how to lift safely.	o	o	o	o
7. Manual lifting control measures are evaluated during assessments.	o	o	o	o
8. Manual lifting incidents are reviewed as part of the HSE Program reviews.	o	o	o	o

		Yes	No	N/A	N/O
9.	Manual lifting incidents are reviewed as part of the HSE Program reviews.	o	o	o	o
Office Environments (5.1.1)		**Yes**	**No**	**N/A**	**N/O**
10.	Employees have received lifting training.	o	o	o	o
11.	Mechanical devices are readily available to employees handling equipment or supplies weighing more than 40 pounds (18 kilograms).	o	o	o	o
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.	o	o	o	o
13.	Employees have received safe lifting training as required by the written site safety plan.	o	o	o	o
Mechanical Lifting (5.2)		**Yes**	**No**	**N/A**	**N/O**
14.	Hand trucks and trolleys are visually inspected before use.	o	o	o	o
15.	Hand trucks and trolleys do not have any broken or damaged parts.	o	o	o	o
16.	Hand truck and trolley paths are free of uneven surfaces, water, oil, or cracks and holes.	o	o	o	o
17.	Loads carried by hand trucks are balanced and sturdy.	o	o	o	o
18.	Hand trucks or dollies are being pushed when on level ground.	o	o	o	o
19.	When going up or down a slope using a hand truck or trolley, the load is downslope of the person.	o	o	o	o
20.	Employees using hand trucks or dollies are moving slowly and cautiously.	o	o	o	o
21.	Employees using hand trucks or trolleys are able to see over the load.	o	o	o	o
Assisted Lifting (5.3)		**Yes**	**No**	**N/A**	**N/O**
22.	Personnel are not performing manual lifting beyond their physical capabilities.	o	o	o	o
23.	Loads are evenly distributed when being handled by multiple people.	o	o	o	o
Manual Lifting (5.4)		**Yes**	**No**	**N/A**	**N/O**
24.	Before the lift, the load and path was assessed.	o	o	o	o
25.	Loads being lifted are free of sharp edges, slivers, or wet or greasy spots.	o	o	o	o
26.	Gloves are used for manual lifts of loads with sharp or splintered edges.	o	o	o	o
27.	Employees performing manual lifts use the proper lifting techniques.	o	o	o	o
28.	Special tools fabricated for lifting grates or manhole covers are used.	o	o	o	o

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.	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist: PERSONAL PROTECTIVE EQUIPMENT

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.	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist: PERSONAL PROTEECTIVE EQUIPMENT

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

Auditor: ________________________________ Project Manager: ___________________________________

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).	☐	☐	☐	☐

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.
Tapers are used to move traffic out of its normal path.	☐	☐	☐	☐
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.	☐	☐	☐	☐

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

CH2MHILL

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 __ Hazard communication
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

Fact Sheets

Lead Fact Sheet

Tick Fact Sheet

Vehicle Accident Guidance

Working Alone

23.1 Lead Fact Sheet

Standard of Practice HSE-508

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^{o}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

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.

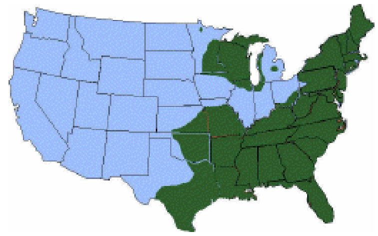
Illnesses and Signs & Symptoms

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)

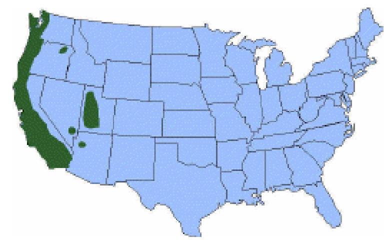
Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, 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



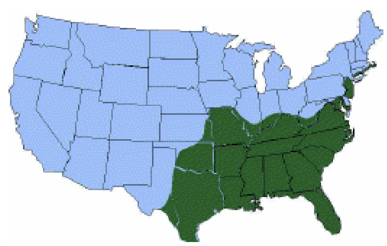
Distribution of Deer Tick (dark green)

From Left: adult female, adult male, nymph, and larvae Deer Tick (cm

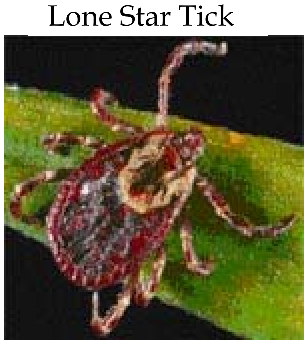


Distribution of Pacific Deer Tick (dark green)

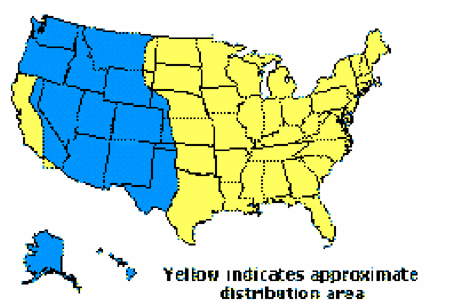
Lone Star Tick



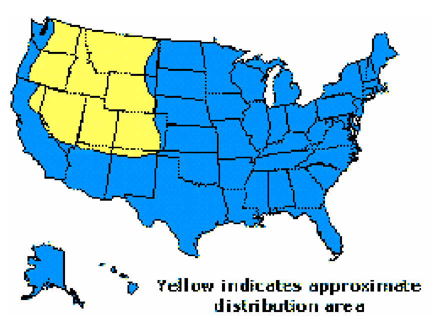
Distribution of Lone Star Tick (Green)



Dog Tick



Rocky Mountain Wood Tick



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.

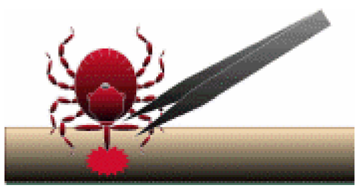
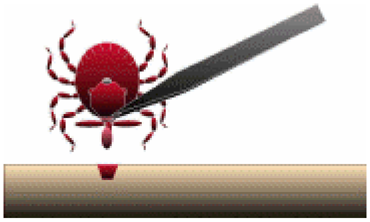
Tick Check

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.
Error! Objects cannot be created from editing field codes.
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.

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.

Please see link below to print out an insurance card (for **CH2M HILL employees** only). The page shows state-specific restrictions and the definitions of hired, owned, etc., vehicles.

https://communities.int.ch2m.com/legal/insurance/Shared%20Documents/AutoID_Cards.aspx?PageView=Shared

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 occupational 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)

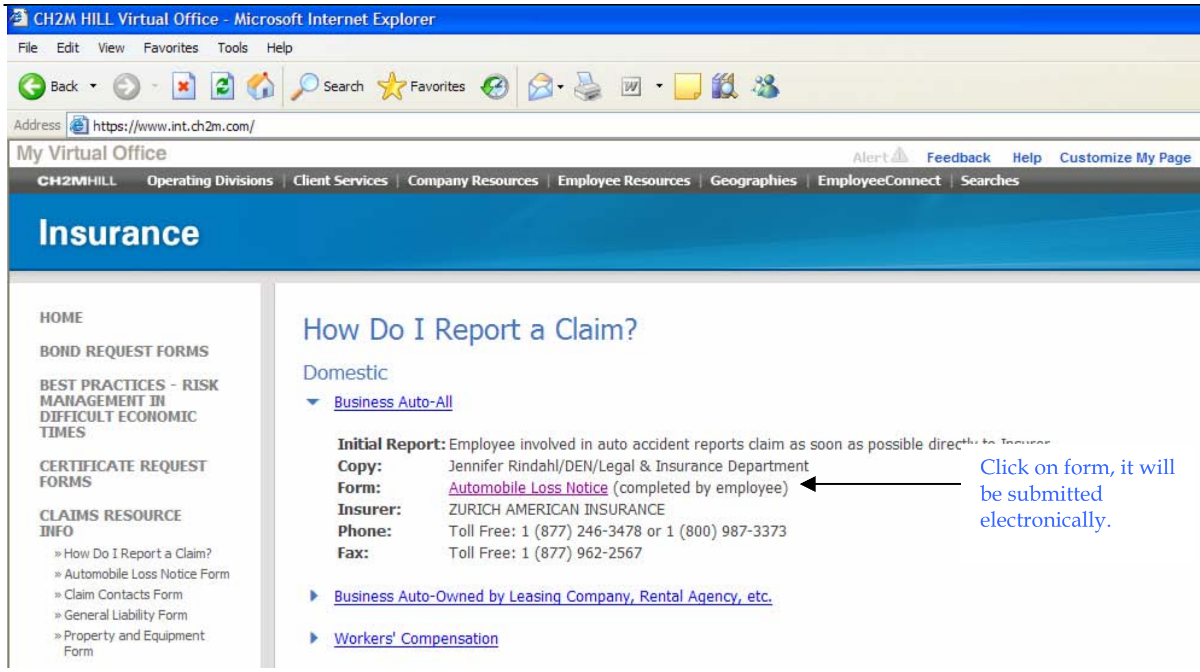
4. Complete a HITS report on the VO.

Additional Steps for FLEET VEHICLES:

Definition: These are vehicles rented for greater than 90 days or rentals that are leased (either through ARI [Automotive Rental, Inc.] or leases from other companies [older fleet vehicles]).

Report the accident to the following:

1. Fill out and Auto Loss Notice on the Virtual Office (click "Company Resources," then "Corporate Groups," then "Insurance"). See screen shot below.



Click on form, it will be submitted electronically.

2. Contact Zurich (1-877-246-3478 or 1-800-987-3373).

3. Contact Linda George/DEN at 720-286-2057.

Note: If you are an ES employee that happens to use an **OMI vehicle** on a project and get into an accident, you must also contact Michelle Garlington/DEN (720-286-4273).

Additional Steps for RENTALS:

1. Fill out and Auto Loss Notice on the Virtual Office (click "Company Resources," then "Corporate Groups," then "Insurance"). See screen shot above.

2. Call 1-800-VISA-911 (**only** if the car has been **rented for less than 31 days**—they provide some additional physical damage coverage in this time period).

3. Call Zurich (1-877-246-3478 or 1-800-987-3373).

4. Call the rental company (Budget, National, Enterprise, etc.).

5. Call Jennifer Rindahl/DEN at 720-286-2449.

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. Refer to the Employee Handbook/Policies, assistance for meeting personal insurance deductibles (up to $500) is available 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:

Business Auto Insurance Manual
https://www.int.ch2m.com/webuploads/newsgenerator/travel/news/business_auto_manual[1].pdf

Claims Resource Manual
https://www.int.ch2m.com/intrnl/voffice/corp/insurance/InsHome.asp

WORKING ALONE PROTOCOL
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:____

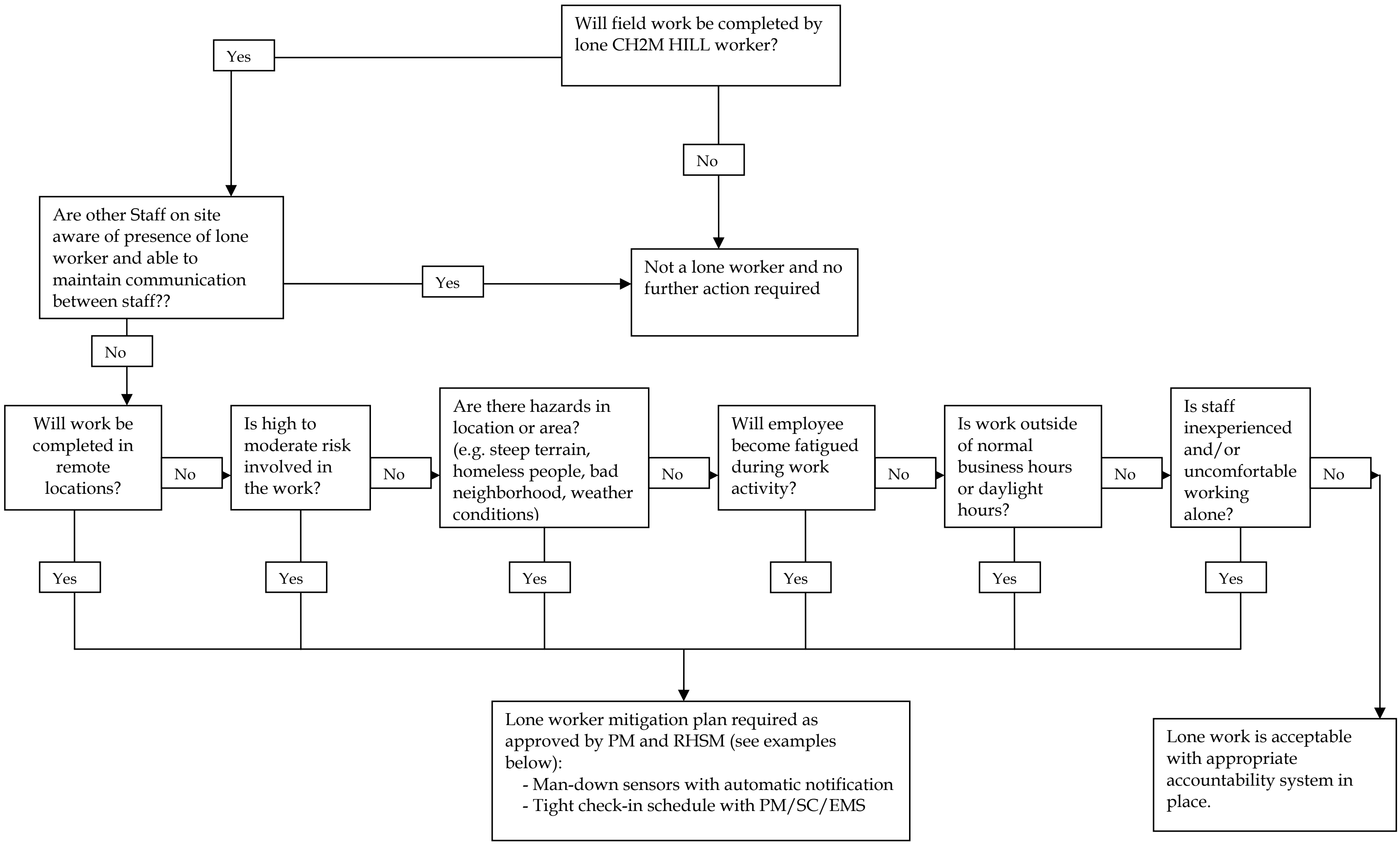
Specified Frequency and time for call in:____

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



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 8

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:**

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 9

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.

Completed CH2M HILL AHAs

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Operating Various Utility Vehicles			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Training on Utility Vehicle	Pre-Mature start-up	• Review Owners/Operational Manual for each type of utility vehicle • Do not operate when fatigued • Always start engine while in operators seat and properly positioned at the vehicle controls • Ensure all levers are in their neutral position before starting engine • Fasten seat belts	Helmet and Standard Level D, D1 or D2 PPE *
Refueling (Fire Hazards)	Slips, Trips, Falls	• Be aware of poor footing, potential slipping/tripping hazards in the work area (i.e. wet/muddy areas or slopes, unprotected holes, ditches, rip rap, utilities or other ground protrusions). Identify and avoid these areas. Wear sturdy hard toe work boots with sufficient ankle support (preferably leather). • 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.	Standard Level D, D1 or D2 PPE *
	Start up/use/refueling	• Ensure Utility Vehicle is off • Do not smoke or use other spark-producing equipment while utility vehicle is in use or during refueling operations	
	Fire Prevention	• Use only metal safety cans for storage and transfer of fuel. • Use funnels and nozzles during fueling operations. • Allow warm engine parts to cool before refueling (if possible). • Appropriately sized, easily accessible ABC fire extinguisher near refueling area. Must be kept no less than 25 feet and no more than 75 feet from the safety cans. • Never refuel while utility vehicle is in operation	
	Fuel Storage	• Use secondary containment for storage • DO NOT store metal safety cans near any flammable materials • A spill kit for handling small scale oil spills will be kept on site	
	Manual Lifting	• CH2M HILL personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn't available to have someone assist with the lift— especially for heavy (> 40lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. • Avoid carrying heavy objects above shoulder level.	

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites
ACTIVITY HAZARD ANALYSIS – Operating Various Utility Vehicles

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Refueling (Fire Hazards) (cont.)	Breakdown & Repairs	• Allow vehicle to cool before servicing • Do not smoke near vehicle • Disconnect battery before working on electrical components • Do not remove radiator cap until cooled • Do not attempt to mount tire on rim • Maintain correct tire pressure • Do not work under hydraulically supported devices	
	Misuse of operational features	• Do not overload and cargo beds (if equipped) • Do not modify any of the features of the engine or transmission • Do not wear headphones or other distracting electronic devices • Stop to answer cell phone even if hands-free option is available • Keep all guards in place • If equipped, do not attempt to turn with the differential locked • Operate dump from operator's seat only • Avoid changing range gear shift lever (if equipped) when ascending or descending a slope • Before ascending or descending a slope, shift to "L" range (if equipped) to control speed	Standard Level D, D1 or D2 PPE *

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Operating Various Utility Vehicles			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Precautions for each Type of Utility Vehicle	Tip or roll over	• Always wear PPE (Steel-toe boots, hard hat, safety glasses and reflective safety vest) when operating vehicle • Avoid sudden starts • Slow down when turning, when on uneven ground, and before stopping to avoid roll-overs • Do not operate near ditches, holes, embankments or other ground features which may cause collapse under the vehicle's weight • Park vehicle on firm flat level ground only, set parking brake and remove key from ignition to prevent non-trained personnel from operating the vehicle • Travel straight up or down slopes, do not sidehill • Keep wheels straight at crest of hill or going over bumps • Reduce load on hilly or rough terrain • Do not stop suddenly when going uphill or downhill • Be especially cautious when changing direction on slopes • If vehicle stops or loses power going up a hill, lock brake to hold vehicle on slope, maintain direction of travel and release brake slowly. Back straight downhill while maintaining control. Do not turn vehicle sideways. Vehicle is more stable in a straight forward or rearward position. • When riding on soft terrain, turn front wheels slightly uphill to keep vehicle on straight line across hill. • If vehicle begins to tip, turn front wheels downhill to gain control • To avoid upsets always back up steep slopes. • Always back out of a ditch, mired condition or steep slopes • Keep all movements on slopes slow and gradual, do not make sudden changes, starts or stops	NA

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites
ACTIVITY HAZARD ANALYSIS – Operating Various Utility Vehicles

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
Precautions for each Type of Utility Vehicle (cont.)	Public road hazards	• Vehicles are not intended for tagged or use on public roads, remain on Public ROW's only, and do not travel on paved streets. • Equip all vehicles with caution triangles and visibility poles including flags • Only operate in daylight hours • Turn headlights on • Always slow vehicle before turning • Use DOT approved hand signals when near public access roads • Drive at speeds that allow you to maintain control • Do not apply differential lock while traveling at a high speed • Avoid sudden motions of the steering wheel • Always keep both hands on the wheel • Keep arms and legs inside of the compartment • No riders allowed in bed, only cargo • Make sure any loads are evenly distributed • Secure all loads	Helmet and Standard Level D, D1 or D2 PPE *
	Failure of safety features	• Perform walk around inspection • Check that fire extinguisher is fully charged and operational • Check engine oil, coolant and all fluid levels • Clean any windshields • Check all gauges functioning properly • Check parking brake • Test Brakes • Check tire inflation • Check seat belts and roll over protection systems (ROPS) • Check lights and backup alarm (if equipped) • Review all posted "safe Operation and Warning" labels • Repair and replace any damaged items, especially seat belts and ROPS	
	Struck by heavy equipment	• Always maintain eye contact with heavy equipment operators and wear high visibility vests when working near heavy equipment • Stay clear of swing areas and pinch points associated with heavy equipment being used	Standard Level D, D1 or D2 PPE *
Inspection of Safety Features	Traffic Congestion	• Be aware of traffic entering, driving through, and exiting the site • Use Proper Road Safety Practices • All traffic will remain clear of work activities	Helmet and Standard Level D, D1 or D2 PPE *

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Operating Various Utility Vehicles			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Travel Around Site	Steep terrain	• Avoid steep terrain	Helmet and Standard Level D, D1 or D2 PPE *
	Road hazards: Uneven surfaces High weeds- fire danger Muddy and wet areas Narrow travel pathways	• Avoid travel off of trails cleared of vegetation, do not traverse the site if possible • Stay on flat even surfaces as much a possible, do not take short cuts or cross country trails • Avoid high weeds and ensure fire extinguisher is operable • Avoid muddy and wet areas • Reduce speeds for narrow areas • Yield right of way to all pedestrians	Helmet and Standard Level D, D1 or D2 PPE *
	Road hazards: Uneven surfaces High weeds- fire danger Muddy and wet areas Narrow travel pathways	• Avoid travel off of trails cleared of vegetation, do not traverse the site if possible • Stay on flat even surfaces as much a possible, do not take short cuts or cross country trails • Avoid high weeds and ensure fire extinguisher is operable • Avoid muddy and wet areas • Reduce speeds for narrow areas • Yield right of way to all pedestrians	Helmet and Standard Level D, D1 or D2 PPE *
	INSPECTION REQUIREMENTS	**TRAINING REQUIREMENTS**	
Notes: * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots, hand and hearing protection, as dictated by task, chemical resistant gloves, disposable suits/boot covers in accordance with the HSP.			• Pre-s

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Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Mobilization/Site Preparation	Slips, Trips, Falls	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet/steep slopes, stumps/roots, unprotected holes, ditches, rip rap, utilities, ground protrusions. Observe and avoid areas of unprotected holes, ramps and ground penetrations or protrusions (stumps, roots, holes curbs, utility structures etc). Use sturdy hard toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices.	Standard Level D PPE * * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots, hand and hearing protection, as dictated by task.
	Heavy Equipment	• Workers to remain beyond the swing radius of heavy equipment. • Communicate with equipment operators with clear hand signals.	Standard Level D PPE
	Manual Lifting	• CH2M HILL or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn't available to have someone assist with the lift— especially for heavy (> 50lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. • Avoid carrying heavy objects above shoulder level.	Standard Level D PPE
	Noise	• Personnel exposed to loud working environments shall wear hearing protection.	Standard Level D PPE
	High Ambient Temperature	• Provide fluids to prevent worker dehydration. • Monitor for heat stress in accordance with HSP (maintain use of buddy system). • Institute a proper work-break regiment to avoid heat stress symptoms and overexertion.	Standard Level D PPE (light colored clothing)
Mobilization/Site Preparation (continued)	Struck/pinched	• Wear reflective warning vests or high visibility clothing. • Isolate equipment swing areas from workers, fixed objects or other equipment. • Make/maintain eye contact with operators before approaching equipment. Do not approach equipment from rear or from blind spot of operator. • Understand and review hand signals. Designate one person to provide hand signals to equipment operators. • Ensure equipment has operable back-up alarms. • Avoid positioning between fixed objects and operating equipment. • No one shall walk under or in front of suspended loads. Only tagged, load rated and inspected rigging shall be used to lift loads. Become familiar with vertical, basket and choker load ratings of rigging.	Standard Level D PPE

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
	Biological	• Observe ground surfaces especially in wet or grassy areas, tree trunks, and rock piles for evidence and presence of snakes (poisonous). • Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives etc. • Observe areas for presence of stinging insects. **Notify supervisors of known allergies to stinging insects and location of antidotes.** • Use insect repellant. Tape pant legs to boots. Frequently check body and clothing for ticks, chiggers, spiders. • Avoid exposure to blood borne pathogens	Standard Level D PPE
	Electric Hazards	• If/when electrical extension cords are required to complete work, extension cords must be: - Equipped with third-wire grounding. - Covered, elevated, or protected from damage when passing through work areas. - Protected from pinching if routed through doorways. - Not fastened with staples, hung from nails, or suspended with wire. - Extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed. - Rated to handle the voltage/amperage of equipment.	Standard Level D PPE
	Fire Prevention	• Use only metal safety cans for storage and transfer of fuel. • Use funnels and nozzles during fueling operations. • Allow warm engine parts (generator motor) to cool before refueling. • Appropriately sized, easily accessible ABC fire extinguisher in work area.	Standard Level D PPE
	Pressure Washing/Equipment Decon	• Only qualified personnel will operate high pressure water cleaning equipment. • Operator will be aware of surroundings at all times. • Operator will never point pressure wand in direction of other personnel. • Pressure wands shall not be modified in field (i.e. shortened, bent, or trigger tied open). • Non-operating support personnel must never walk in front of operator during operation. • High pressure equipment shall be equipped with pressure dump safety valves. • Operator to wear pressure resistant foot wear and face splash shield. • Operator shall inspect high pressure hoses, fittings and safety equipment daily.	Modified Level D PPE with pressure resistant footwear and face splash shield

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Mobilization/Site Preparation			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
	Other	• Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. • Shut down operations in heavy rain and lightning. • Buddy System maintained for all phases of work. • Base Emergency Dispatch numbers programmed into CH2M HILL personnel cellular phones. Have hospital route maps readily available. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Site work should always be performed with adequate lighting. • Site equipment, materials, and waste should be maintained according to good housekeeping practices.	NA

EQUIPMENT REQUIRED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Fire extinguisher (with fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • Miscellaneous rigging.	• Visual Inspections of designated work areas identify and address hazardous conditions. • Equipment inspections and maintenance. • Inspections of hand tools (power) and extension chords if used.	• Review AHA with all task personnel • Review Site Specific Health and Safety Plan for new site personnel. • Review operations/safety manuals for all equipment utilized. • Behavior Based Loss Prevention Training (supervisors). • Power tool and equipment operators qualified by previous training or experience.

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Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Utility Location			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Mobilize to utility designation location	**Driving Hazards** – mobilization to and from and traffic movement in areas of designation	• Driving – drive defensively and obey all traffic laws; • Establish route to site prior to trip and park vehicles in a secure area out of vehicle and pedestrian traffic; • Set up traffic control measures, if necessary on site;	Standard Level D PPE * * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots
Confirmation of area being designated and inspection/review of designation equipment	**Traffic** – observing ingress & egress of vehicular & pedestrian traffic; **Fall** – caution in locating possible landscape irregularities; **Exertion** – lifting and maneuvering equipment **Biological Hazards** – Insects and poisonous plants	• Perform tailgate safety meeting covering the scope of the job and any safety issues specific to the site/sites being designated. • Inspection of equipment for proper operation. • Employees will wear hi-visibility vests, long pants and bug spray during site activities and additional protective clothing (i.e. longsleeves, taped pants, light colors, etc) as necessary to protect against biological hazards. • Observe ground surfaces especially in wet or grassy areas, tree trunks, and rock piles for evidence and presence of snakes (poisonous). • Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives etc. • Observe areas for presence of stinging insects. **Notify supervisors of known allergies to stinging insects and location of antidotes.** • Use insect repellant. Tape pant legs to boots. Frequently check body and clothing for ticks, chiggers, spiders. • Avoid exposure to blood borne pathogens	Standard Level D PPE Bug-out suits if needed
Designation of utilities as defined by the scope of work	**Traffic, Fall, Exertion (see descriptions above) and Exposure** – heat exhaustion during the summer months and cold during the winter months **Exposed Energized Electrical Contact Points** – Contact with exposed electrical contact points **Biological Hazards** – Insects and poisonous plants	• Perform designation duties by first verifying the proper operation of equipment, inspecting the designation area for possible hazards (holes, ruts, objects, etc.) that could cause injury; using proper bending/lifting techniques to minimize injury (bending at the knee and lifting with your legs); • wearing appropriate personal protective equipment (PPE); • taking sufficient break periods and consumption of appropriate amounts of fluids to replenish loss from heat exposure and or access to a heated area and breaks during cold weather months. • Additionally, employees will be familiar with the symptoms of heat stress and heat exhaustion. • Employees will wear long pants and bug spray during site activities and additional protective clothing (i.e. longsleeves, taped pants, light colors, etc) as necessary to protect against biological hazards. • Do not tie into energized lines with exposed electrical contact points. • Observe ground surfaces especially in wet or grassy areas, tree trunks, and rock piles for evidence and presence of snakes (poisonous). • Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives etc. • Observe areas for presence of stinging insects. **Notify supervisors of known allergies to stinging insects and location of antidotes.** • Use insect repellant. Tape pant legs to boots. Frequently check body and clothing for ticks, chiggers, spiders. • Avoid exposure to blood borne pathogens	Standard Level D PPE Bug-out suits if needed

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Utility Location			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Leaving designation site and loading truck	**Traffic, Exertion**	• Remove all equipment/supplies from the work area and use appropriate bending/lifting procedures (bending from the knees and lifting with your legs) when loading equipment into the truck; • visually scan all areas to insure that all equipment/supplies have been accounted for and placed in the truck.	Standard Level D PPE
Depart from site	**Traffic**	• Drive defensively and obey all traffic laws; • establish exit from site prior to leaving the area and be aware of vehicle and pedestrian traffic	Standard Level D PPE

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Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Soil, Sediment, Surface Water, and Groundwater Sampling			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Soil and Groundwater Sampling	Slips, Trips, Falls	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet/steep slopes, stumps/roots, unprotected holes, ditches, rip rap, utilities, ground protrusions. Observe and avoid areas of unprotected holes, ramps and ground penetrations or protrusions (stumps, roots, holes curbs, utility structures etc). Use sturdy hard toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices.	Standard Level D PPE * * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots, hand and hearing protection, as dictated by task.
	Chemical Exposure	• All personnel performing this task shall be trained in accordance with 29CFR1910.120 and be deemed “fit for duty” by a licensed occupation physician. • Follow PPE and action level requirements identified in the site specific HSP. • Do not allow dermal contact or incidental ingestion of impacted soil or groundwater. Skin contact with contaminated water, soils, debris, or equipment shall be avoided at all times. Do not kneel or step in potentially contaminated media (soil or ground water). • Exercise good hygiene practices. Always wash hands before eating, drinking, smoking and leaving site. Only eat, drink, smoke or chew tobacco in designated areas. • Following sample collection, sample container lids should be tightened securely to prevent any leaks, and the containers should be rinsed with clean water to ensure that they are free of chemical constituents.	Modified Level D PPE (see table in Section 14)
	Manual Lifting	• CH2M HILL or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn’t available to have someone assist with the lift— especially for heavy (> 50lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. • Avoid carrying heavy objects above shoulder level.	Standard Level D PPE
	Noise	• Personnel exposed to loud working environments shall wear hearing protection.	Standard Level D PPE
	High Ambient Temperature	• Provide fluids to prevent worker dehydration. • Monitor for heat stress in accordance with HSP (maintain use of buddy system). • Institute a proper work-break regiment to avoid heat stress symptoms and overexertion.	Standard Level D PPE (light colored clothing)

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Soil, Sediment, Surface Water, and Groundwater Sampling			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
	Struck/pinched	• Wear reflective warning vests or high visibility clothing. • Isolate equipment swing areas from workers, fixed objects or other equipment. • Make/maintain eye contact with operators before approaching equipment. Do not approach equipment from rear or from blind spot of operator. • Understand and review hand signals. Designate one person to provide hand signals to equipment operators. • Ensure equipment has operable back-up alarms. • Avoid positioning between fixed objects and operating equipment. • No one shall walk under or in front of suspended loads. Only tagged, load rated and inspected rigging shall be used to lift loads. Become familiar with vertical, basket and choker load ratings of rigging.	Standard Level D PPE
Sediment/Surface water Sampling (continued)	Biological	• Observe ground surfaces especially in wet or grassy areas, tree trunks, and rock piles for evidence and presence of snakes (poisonous). • Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives etc. • Observe areas for presence of stinging insects. **Notify supervisors of known allergies to stinging insects and location of antidotes.** • Use insect repellant. Tape pant legs to boots. Frequently check body and clothing for ticks, chiggers, spiders. • Avoid exposure to blood borne pathogens	Standard Level D PPE Bug-out suits if needed
	Electric Hazards	• If/when electrical extension cords are required to complete work, extension cords must be: - Equipped with third-wire grounding. - Covered, elevated, or protected from damage when passing through work areas. - Protected from pinching if routed through doorways. - Not fastened with staples, hung from nails, or suspended with wire. - Extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed. - Rated to handle the voltage/amperage of equipment.	Standard Level D PPE
	Fire Prevention	• Use only metal safety cans for storage and transfer of fuel. • Use funnels and nozzles during fueling operations. • Allow warm engine parts (generator motor) to cool before refueling. • Appropriately sized, easily accessible ABC fire extinguisher in work area.	Standard Level D PPE
	Pressure Washing/Equipment Decon	• Only qualified personnel will operate high pressure water cleaning equipment. • Operator will be aware of surroundings at all times. • Operator will never point pressure wand in direction of other personnel. • Pressure wands shall not be modified in field (i.e. shortened, bent, or trigger tied open). • Non-operating support personnel must never walk in front of operator during operation. • High pressure equipment shall be equipped with pressure dump safety valves. • Operator to wear pressure resistant foot wear and face splash shield. • Operator shall inspect high pressure hoses, fittings and safety equipment daily.	Modified Level D PPE with pressure resistant footwear and face splash shield

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites
ACTIVITY HAZARD ANALYSIS – Soil, Sediment, Surface Water, and Groundwater Sampling

Task Breakdown	Potential Hazards	Critical Safety Practices	Personal Protective Clothing and Equipment
	Chemical Exposure	• All personnel performing this task shall be trained in accordance with 29CFR1910.120 and be deemed "fit for duty" by a licensed occupation physician. • Follow PPE and action level requirements identified in the site specific HSP. • Do not allow dermal contact or incidental ingestion of impacted soil or groundwater. Skin contact with contaminated water, soils, debris, or equipment shall be avoided at all times. Do not kneel or step in potentially contaminated media (soil or ground water). • Exercise good hygiene practices. Always wash hands before eating, drinking, smoking and leaving site. Only eat, drink, smoke or chew tobacco in designated areas. • Following sample collection, sample container lids should be tightened securely to prevent any leaks, and the containers should be rinsed with clean water to ensure that they are free of chemical constituents.	Modified Level D PPE (see table in Section 14)
	Other	• Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Shut down operations in heavy rain and lightning. • Buddy System maintained for all phases of work. • Base Emergency Dispatch numbers programmed into CH2M HILL personnel cellular phones. Have hospital route maps readily available. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Site work should always be performed with adequate lighting. • Site equipment, materials, and waste should be maintained according to good housekeeping practices.	NA

EQUIPMENT REQUIRED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Fire extinguisher (with fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • Miscellaneous rigging.	• Visual Inspections of designated work areas identify and address hazardous conditions. • Equipment inspections and maintenance. • Inspections of hand tools (power) and extension cords if used.	• Review AHA with all task personnel • Review Site Specific Health and Safety Plan for new site personnel. • Review operations/safety manuals for all equipment utilized. • Behavior Based Loss Prevention Training (supervisors). • Power tool and equipment operators qualified by previous training or experience.

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Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Equipment Decontamination			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Equipment Decontamination	Slips, Trips, Falls	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet/steep slopes, stumps/roots, unprotected holes, ditches, rip rap, utilities, ground protrusions. Observe and avoid areas of unprotected holes, ramps and ground penetrations or protrusions (stumps, roots, holes curbs, utility structures etc). Use sturdy hard toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices.	Standard Level D PPE * * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots, hand and hearing protection, as dictated by task.
	Heavy Equipment/Haul Trucks	• Operator experienced with safe operation of excavation/loading equipment. • Workers to remain beyond the swing radius of heavy equipment. • Workers to remain out of the haul route when possible. • Communicate with equipment and haul truck operators with clear hand signals.	Standard Level D PPE
	Manual Lifting	• CH2M HILL or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn't available to have someone assist with the lift— especially for heavy (> 50lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. • Avoid carrying heavy objects above shoulder level.	Standard Level D PPE
	Noise	• Personnel exposed to loud working environments shall wear hearing protection.	Standard Level D PPE
	High Ambient Temperature	• Provide fluids to prevent worker dehydration. • Monitor for heat stress in accordance with HSP (maintain use of buddy system). • Institute a proper work-break regiment to avoid heat stress symptoms and overexertion.	Standard Level D PPE (light colored clothing)
	Struck/pinched	• Wear reflective warning vests or high visibility clothing. • Isolate equipment swing areas from workers, fixed objects or other equipment. • Make/maintain eye contact with operators before approaching equipment. Do not approach equipment from rear or from blind spot of operator. • Understand and review hand signals. Designate one person to provide hand signals to equipment operators. • Ensure equipment has operable back-up alarms. • Avoid positioning between fixed objects and operating equipment. • No one shall walk under or in front of suspended loads. Only tagged, load rated and inspected rigging shall be used to lift loads. Become familiar with vertical, basket and choker load ratings of rigging.	Standard Level D PPE

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Equipment Decontamination			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Equipment Decontamination (continued)	Biological	• Observe ground surfaces especially in wet or grassy areas, tree trunks, and rock piles for evidence and presence of snakes (poisonous). • Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives etc. • Observe areas for presence of stinging insects. **Notify supervisors of known allergies to stinging insects and location of antidotes.** • Use insect repellant. Tape pant legs to boots. Frequently check body and clothing for ticks, chiggers, spiders. • Avoid exposure to blood borne pathogens	Standard Level D PPE
	Electric Hazards	• If/when electrical extension cords are required to complete work, extension cords must be: - Equipped with third-wire grounding. - Covered, elevated, or protected from damage when passing through work areas. - Protected from pinching if routed through doorways. - Not fastened with staples, hung from nails, or suspended with wire. - Extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed. - Rated to handle the voltage/amperage of equipment.	Standard Level D PPE
	Fire Prevention	• Use only metal safety cans for storage and transfer of fuel. • Use funnels and nozzles during fueling operations. • Allow warm engine parts (generator motor) to cool before refueling. • Appropriately sized, easily accessible ABC fire extinguisher in work area.	Standard Level D PPE
	Pressure Washing/Equipment Decon	• Only qualified personnel will operate high pressure water cleaning equipment. • Operator will be aware of surroundings at all times. • Operator will never point pressure wand in direction of other personnel. • Pressure wands shall not be modified in field (i.e. shortened, bent, or trigger tied open). • Non-operating support personnel must never walk in front of operator during operation. • High pressure equipment shall be equipped with pressure dump safety valves. • Operator to wear pressure resistant foot wear and face splash shield. • Operator shall inspect high pressure hoses, fittings and safety equipment daily.	Modified Level D PPE with pressure resistant footwear and face splash shield
	Overhead/Suspended Loads	• No personnel are allowed to walk under elevated buckets on excavation equipment • If personnel have to work beneath elevated buckets for maintenance purpose, then safety blocks must be positioned on hydraulic arms to prevent lowering. • Hardhats to be worn at all times if potential for falling objects	Standard Level D PPE

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Equipment Decontamination			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Equipment Decontamination (continued)	Chemical Exposure	• All personnel performing this task shall be trained in accordance with 29CFR1910.120 and be deemed "fit for duty" by a licensed occupation physician. • Follow PPE and action level requirements identified in the site specific HSP. • Do not allow dermal contact or incidental ingestion of impacted soil or groundwater. Skin contact with contaminated water, soils, debris, or equipment shall be avoided at all times. Do not kneel or step in potentially contaminated media (soil or ground water). • Exercise good hygiene practices. Always wash hands before eating, drinking, smoking and leaving site. Only eat, drink, smoke or chew tobacco in designated areas. • Following sample collection, sample container lids should be tightened securely to prevent any leaks, and the containers should be rinsed with clean water to ensure that they are free of chemical constituents.	Modified Level D_1 or D_2 PPE (see table G5-1)
	Other	• Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. • Shut down operations in heavy rain and lightning. • Buddy System maintained for all phases of work. • Base Emergency Dispatch numbers programmed into CH2M HILL personnel cellular phones. Have hospital route maps readily available. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Site work should always be performed with adequate lighting. • Site equipment, materials, and waste should be maintained according to good housekeeping practices.	NA

EQUIPMENT REQUIRED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Fire extinguisher (with fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • Miscellaneous rigging.	• Visual Inspections of designated work areas identify and address hazardous conditions. • Equipment inspections and maintenance. • Inspections of hand tools (power) and extension cords if used.	• Review AHA with all task personnel • Review Site Specific Health and Safety Plan for new site personnel. • Review operations/safety manuals for all equipment utilized. • Behavior Based Loss Prevention Training (supervisors). • Power tool and equipment operators qualified by previous training or experience.

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Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – IDW Handling and Management			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
IDW Handling and Management	Slips, Trips, Falls	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet/steep slopes, stumps/roots, unprotected holes, ditches, rip rap, utilities, ground protrusions. Observe and avoid areas of unprotected holes, ramps and ground penetrations or protrusions (stumps, roots, holes curbs, utility structures etc). Use sturdy hard toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices.	Standard Level D PPE * * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots, hand and hearing protection, as dictated by task.
	Heavy Equipment/Haul Trucks	• Operator experienced with safe operation of excavation/loading equipment. • Workers to remain beyond the swing radius of heavy equipment. • Workers to remain out of the haul route when possible. • Communicate with equipment and haul truck operators with clear hand signals.	Standard Level D PPE
	Manual Lifting	• CH2M HILL or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn't available to have someone assist with the lift— especially for heavy (> 50lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. • Avoid carrying heavy objects above shoulder level.	Standard Level D PPE
	Noise	• Personnel exposed to loud working environments shall wear hearing protection.	Standard Level D PPE
	High Ambient Temperature	• Provide fluids to prevent worker dehydration. • Monitor for heat stress in accordance with HSP (maintain use of buddy system). • Institute a proper work-break regiment to avoid heat stress symptoms and overexertion.	Standard Level D PPE (light colored clothing)
	Struck/pinched	• Wear reflective warning vests or high visibility clothing. • Isolate equipment swing areas from workers, fixed objects or other equipment. • Make/maintain eye contact with operators before approaching equipment. Do not approach equipment from rear or from blind spot of operator. • Understand and review hand signals. Designate one person to provide hand signals to equipment operators. • Ensure equipment has operable back-up alarms. • Avoid positioning between fixed objects and operating equipment. • No one shall walk under or in front of suspended loads. Only tagged, load rated and inspected rigging shall be used to lift loads. Become familiar with vertical, basket and choker load ratings of rigging.	Standard Level D PPE

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – IDW Handling and Management			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
IDW Handling and Management (continued)	Biological	• Observe ground surfaces especially in wet or grassy areas, tree trunks, and rock piles for evidence and presence of snakes (poisonous). • Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives etc. • Observe areas for presence of stinging insects. **Notify supervisors of known allergies to stinging insects and location of antidotes.** • Use insect repellant. Tape pant legs to boots. Frequently check body and clothing for ticks, chiggers, spiders. • Avoid exposure to blood borne pathogens	Standard Level D PPE
	Fire Prevention	• Use only metal safety cans for storage and transfer of fuel. • Use funnels and nozzles during fueling operations. • Allow warm engine parts (generator motor) to cool before refueling. • Appropriately sized, easily accessible ABC fire extinguisher in work area.	Standard Level D PPE
	Overhead/Suspended Loads	• No personnel are allowed to walk under elevated buckets on excavation equipment • If personnel have to work beneath elevated buckets for maintenance purpose, then safety blocks must be positioned on hydraulic arms to prevent lowering. • Hardhats to be worn at all times if potential for falling objects	Standard Level D PPE
	Chemical Exposure	• All personnel performing this task shall be trained in accordance with 29CFR1910.120 and be deemed "fit for duty" by a licensed occupation physician. • Follow PPE and action level requirements identified in the site specific HSP. • Do not allow dermal contact or incidental ingestion of impacted soil or groundwater. Skin contact with contaminated water, soils, debris, or equipment shall be avoided at all times. Do not kneel or step in potentially contaminated media (soil or ground water). • Exercise good hygiene practices. Always wash hands before eating, drinking, smoking and leaving site. Only eat, drink, smoke or chew tobacco in designated areas. • Following sample collection, sample container lids should be tightened securely to prevent any leaks, and the containers should be rinsed with clean water to ensure that they are free of chemical constituents.	Modified Level D_1 or D_2 PPE (see table G5-1)

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – IDW Handling and Management			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
IDW Handling and Management (continued)	Other	• Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. • Shut down operations in heavy rain and lightning. • Buddy System maintained for all phases of work. • Base Emergency Dispatch numbers programmed into CH2M HILL personnel cellular phones. Have hospital route maps readily available. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Site work should always be performed with adequate lighting. • Site equipment, materials, and waste should be maintained according to good housekeeping practices.	NA

EQUIPMENT REQUIRED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Fire extinguisher (with fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • Miscellaneous rigging.	• Visual Inspections of designated work areas identify and address hazardous conditions. • Equipment inspections and maintenance. • Inspections of hand tools (power) and extension chords if used.	• Review AHA with all task personnel • Review Site Specific Health and Safety Plan for new site personnel. • Review operations/safety manuals for all equipment utilized. • Behavior Based Loss Prevention Training (supervisors). • Power tool and equipment operators qualified by previous training or experience.

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Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Demobilization / Cleanup			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Demobilization/ Cleanup	Slips, Trips, Falls	• Be aware of poor footing, potential slipping/tripping hazards in the work area, such as wet/steep slopes, stumps/roots, unprotected holes, ditches, rip rap, utilities, ground protrusions. Observe and avoid areas of unprotected holes, ramps and ground penetrations or protrusions (stumps, roots, holes curbs, utility structures etc). Use sturdy hard toe work boots with sufficient ankle support. • Institute and maintain good housekeeping practices.	Standard Level D PPE * * Work clothes, reflective vests/ high visibility clothing, hard hat, safety glasses and sturdy hard toed work boots, hand and hearing protection, as dictated by task.
	Heavy Equipment/Haul Trucks	• Operator experienced with safe operation of excavation/loading equipment. • Workers to remain beyond the swing radius of heavy equipment. • Workers to remain out of the haul route when possible. • Communicate with equipment and haul truck operators with clear hand signals.	Standard Level D PPE
	Manual Lifting	• CH2M HILL or subcontract personnel must notify supervisors or safety representatives of preexisting medical conditions that may be aggravated or re-injured by lifting activities. • When lifting objects, lift using knees not back. For repetitive lifting tasks, the use of lifting braces/supports may be considered. If heavy equipment isn't available to have someone assist with the lift— especially for heavy (> 50lbs.) or awkward loads. Use heavy equipment to transfer heavy or awkward loads wherever possible. • Plan storage and staging to minimize lifting or carrying distances. Make sure the path of travel is clear prior to the lift. • Avoid carrying heavy objects above shoulder level.	Standard Level D PPE
	Noise	• Personnel exposed to loud working environments shall wear hearing protection.	Standard Level D PPE
	High Ambient Temperature	• Provide fluids to prevent worker dehydration. • Monitor for heat stress in accordance with HSP (maintain use of buddy system). • Institute a proper work-break regiment to avoid heat stress symptoms and overexertion.	Standard Level D PPE (light colored clothing)
Demobilization/ Cleanup (continued)	Struck/pinched	• Wear reflective warning vests or high visibility clothing. • Isolate equipment swing areas from workers, fixed objects or other equipment. • Make/maintain eye contact with operators before approaching equipment. Do not approach equipment from rear or from blind spot of operator. • Understand and review hand signals. Designate one person to provide hand signals to equipment operators. • Ensure equipment has operable back-up alarms. • Avoid positioning between fixed objects and operating equipment. • No one shall walk under or in front of suspended loads. Only tagged, load rated and inspected rigging shall be used to lift loads. Become familiar with vertical, basket and choker load ratings of rigging.	Standard Level D PPE

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Demobilization / Cleanup			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
	Biological	• Observe ground surfaces especially in wet or grassy areas, tree trunks, and rock piles for evidence and presence of snakes (poisonous). • Observe ground surfaces or surrounding vegetation or structures for presence fire ants, spiders, bee/wasp hives etc. • Observe areas for presence of stinging insects. **Notify supervisors of known allergies to stinging insects and location of antidotes.** • Use insect repellant. Tape pant legs to boots. Frequently check body and clothing for ticks, chiggers, spiders. • Avoid exposure to blood borne pathogens	Standard Level D PPE
	Electric Hazards	• If/when electrical extension cords are required to complete work, extension cords must be: - Equipped with third-wire grounding. - Covered, elevated, or protected from damage when passing through work areas. - Protected from pinching if routed through doorways. - Not fastened with staples, hung from nails, or suspended with wire. - Extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed. - Rated to handle the voltage/amperage of equipment.	Standard Level D PPE
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	Pressure Washing/Equipment Decon	• Only qualified personnel will operate high pressure water cleaning equipment. • Operator will be aware of surroundings at all times. • Operator will never point pressure wand in direction of other personnel. • Pressure wands shall not be modified in field (i.e. shortened, bent, or trigger tied open). • Non-operating support personnel must never walk in front of operator during operation. • High pressure equipment shall be equipped with pressure dump safety valves. • Operator to wear pressure resistant foot wear and face splash shield. • Operator shall inspect high pressure hoses, fittings and safety equipment daily.	Modified Level D PPE with pressure resistant footwear and face splash shield
	Overhead/Suspended Loads	• No personnel are allowed to walk under elevated buckets on excavation equipment • If personnel have to work beneath elevated buckets for maintenance purpose, then safety blocks must be positioned on hydraulic arms to prevent lowering. • Hardhats to be worn at all times if potential for falling objects	Standard Level D PPE

Contract Task Order WE41 MCB Camp Lejeune- Multiple MMRP Sites ACTIVITY HAZARD ANALYSIS – Demobilization / Cleanup			
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**
Demobilization/ Cleanup (continued)	Other	• Always using a seat belt while driving on military/government facilities. Always observe posted speed limits, traffic signs and signals. Never using a cell phone or two way radio while driving on military/government facilities. Violating these rules may result in loss of military/government facility driving privileges. • Shut down operations in heavy rain and lightning. • Buddy System maintained for all phases of work. • Base Emergency Dispatch numbers programmed into CH2M HILL personnel cellular phones. Have hospital route maps readily available. • Report all unsafe conditions and acts, injury/illness or property damage to supervisors immediately. • Site work should always be performed with adequate lighting. • Site equipment, materials, and waste should be maintained according to good housekeeping practices.	NA

EQUIPMENT REQUIRED	INSPECTION REQUIREMENTS	TRAINING REQUIREMENTS
• Fire extinguisher (with fuel and electrical sources) • Eye wash (small portable type) • Miscellaneous power and manual hand tools. • Miscellaneous rigging.	• Visual Inspections of designated work areas identify and address hazardous conditions. • Equipment inspections and maintenance. • Inspections of hand tools (power) and extension chords if used.	• Review AHA with all task personnel • Review Site Specific Health and Safety Plan for new site personnel. • Review operations/safety manuals for all equipment utilized. • Behavior Based Loss Prevention Training (supervisors). • Power tool and equipment operators qualified by previous training or experience.

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CH2M HILL HEALTH AND SAFETY PLAN

Attachment 11

Material Safety Data Sheets

Appendix B
UFP-SAP (for Site UXO-02 and UXO-14) and UFP-SAP (for Site UXO-11 and USO-17)

SAP Worksheet #1: Title and Approval Page

Final

Sampling and Analysis Plan Intrusive Investigation for Military Munitions Response Program; Sites Unexploded Ordnance (UXO)-11 - Former B-5 Practice Hand Grenade Course (ASR #2.81) and UXO-17 - Former Firing Position 2 (ASR #2.12)

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

CTO-WE41

September 2011

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

Knoxville, Tennessee

Review Signature:

Keith LaTorre, Date
CH2M HILL – Project Manager

Chris Bozzini Date
CH2M HILL – Activity Quality Manager

Approval Signature:

Jan Nielsen Date
NAVFAC Atlantic – Chemist/QA Officer

Other Approval Signature:

Dave Cleland Date
NAVFAC Mid-Atlantic – Remedial Project Manager

Gena Townsend Date
USEPA Region 4 – Remedial Project Manager

Marti Morgan Date
NCDENR – Remedial Project Manager

Executive Summary

This document presents the plan for the intrusive investigation including environmental sampling at Site Unexploded Ordnance (UXO)-11, Former B-5 Practice Hand Grenade Course (ASR #2.81), and Site UXO-17 - Former Firing Position 2 (ASR #2.12), herein referred to as Site UXO-11 and UXO-17, located at MCB Camp Lejeune (MCB CamLej) in Jacksonville, North Carolina.

CH2M HILL prepared this document under the U.S. Navy, Naval Facilities Engineering Command (NAVFAC) Atlantic Division, Comprehensive Long-Term Environmental Action - Navy (CLEAN) 1000 Contract N62470-08-D-1000, Contract Task Order (CTO) WE41 in accordance with the Navy's Uniform Federal Policy Sampling Analysis Plan (UFP-SAP) policy guidance to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses. The *Site Management Plan, Fiscal Year 2010, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (CH2M HILL, 2010a) provides additional information and background on MCB CamLej. This intrusive investigation will be conducted under Contract Task Order WE41, Modification 1 and Modification 3.

Environmental Conservation Laboratories, Jacksonville and Orlando, Florida, and GEL Laboratories, Charleston, South Carolina will be responsible for analyzing environmental samples from Site UXO-11 and UXO-17. If additional laboratory services are requested requiring modification to the existing SAP, revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval.

The primary objective of this sampling and analysis plan (SAP) is to further characterize previously identified potential human health and ecological risks at Site UXO-11 and UXO-17. At Site UXO-11, surface and subsurface soil, sediment, surface water, and groundwater sampling will be performed to collect additional data regarding the distribution of explosives residues and chromium within environmental media at the site. At Site UXO-17, groundwater sampling will be performed to evaluate whether a leaking 55-gallon drum containing an unknown substance, found during the 2011 expanded Site Inspection, has impacted groundwater at the site. If MEC is identified and destroyed at either site, surface soil samples will be collected to evaluate impact by munitions constituents (MC) resulting from demolition. Analytical data from these sampling efforts will be used to determine if additional assessment or interim action is warranted.

UFP-SAP Outline

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

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

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SAP Worksheets

Attachments

Figures

Acronyms and Abbreviations

AES	atomic emission spectrometer
AHA	activity hazard analysis
AM	activity manager
APP	accident prevention plan
AQM	activity quality manager
ASR	archive search report
bgs	below ground surface
BHC	benzene hexachloride
BIP	blow-in-place
CA	corrective action
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chain of custody
CSM	conceptual site model
CTO	Contract Task Order
DDT	dichlorodiphenyltrichloroethane
DGM	digital geophysical mapping
DMM	discarded military munitions
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
DQI	data quality indicator
DQO	data quality objective
DV	data validation
ELAP	Environmental Laboratory Accreditation Program
EDD	Electronic Data Deliverable
EMD	Environmental Management Division
ERS	ecological risk screening
ft	feet
FTL	field team leader
GC	gas chromatograph
gpm	gallons per minute
GPS	Global Positioning System
GW	groundwater
HHRS	human health risk screening
H&S	health and safety
HPLC	high pressure liquid chromatograph
HSM	health and safety manager
HSP	health and safety plan

ICAL	initial calibration
ICP	inductively coupled plasma
ICV	initial calibration verification
IDL	instrument detection limit
IDW	investigation-derived waste
IS	internal standard
kg	kilogram
LCS	laboratory control sample
LIMS	Laboratory Information Management System
LODV	Limit of Detection Verification
MC	munitions constituents
MCB CamLej	Marine Corps Base Camp Lejeune
MCL	maximum contaminant level
MDL	method detection limit
MEC	munitions and explosives of concern
mg	milligram
MPPEH	material potentially presenting and explosive hazard
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NAVFAC	Naval Facilities Engineering Command, Mid-Atlantic
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	NCAC 2L Groundwater Quality Standards
NIRIS	Naval Installation Restoration Information Solution
NRWQC	Nationally Recommended Water Quality Criteria
ORP	oxidation-reduction potential
ORR	Operational Readiness Review
PA/SI	preliminary assessment/site inspection
PAL	project action limit
PC	project chemist
PE	Professional Engineer
PETN	pentaerythritol tetranitrate
PG	Professional Geologist
PM	Project Manager
POC	point of contact
PQL	project quantitation limit
PQO	project quality objective
PVC	polyvinyl chloride
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control

QL	quantitation limit
QSM	Quality Systems Manual
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RSLs	Regional Screening Levels
RT	retention time
SAP	sampling and analysis plan
SB	subsurface soil
SD	sediment
SOP	standard operating procedure
SS	surface soil
SSC	site safety coordinator
SSL	Soil Screening Level
SVOC	semivolatile organic compounds
SW	surface water
TAL	target analyte list
TBD	to be determined
TCE	trichloroethene
TOC	total organic carbon
UFP	Uniform Federal Policy
ug	microgram
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VOC	volatile organic compounds
WQP	water quality parameter

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SAP Worksheet #2: Sampling and Analysis Plan Identifying Information

Site Name/Number: Site UXO-11 and Site UXO-17

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): CTO WE41

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

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

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

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SAP Worksheet #3: Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Dave Cleland	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	(757) 322-4851	david.t.cleland@navy.mil
Charity Rychak	Environmental Engineer	MCB CamLej - Environmental Management Division (EMD)	(910) 451-9386	charity.rychak@usmc.mil
Gena Townsend	Remedial Project Manager (RPM)	USEPA Region 4	(404) 562-8538	towsend.gena@epa.gov
Marti Morgan	RPM	NCDENR	(919) 508-8447	martha.morgan@ncdenr.gov
Matt Louth	Activity Manager (AM)	CH2M HILL	(757) 671-6240	matt.louth@ch2m.com
Tom Roth	Senior MR Consultant / Activity Quality Manager (AQM)	CH2M HILL	(404) 474-7640	tom.roth@ch2m.com
Teg Williams	Senior Technical Consultant	CH2M HILL	(704) 543-3297	tegwyn.williams@ch2m.com
Keith LaTorre	Project Manager (PM)	CH2M HILL	(865) 769-3204	keith.latorre@ch2m.com
Lael Feist	Task Manager	CH2M HILL	(256) 529-7671	laelruth.feist@ch2m.com
Paul Favara	UFP-SAP Reviewer	CH2M HILL	(352) 384-7067	paul.favara@ch2m.com
Carl Woods	Health & Safety (H&S) Manager	CH2M HILL	(513) 889-5771	carl.woods@ch2m.com
Roni Warren	Human Health Risk Assessor (HHRA)	CH2M HILL	(814) 364-2454	roni.warren@ch2m.com
Jonathon Weier	Ecological Risk Assessor (ERA)	CH2M HILL	(770) 485-7503	jonathon.weier@ch2m.com
David Seed	Field Team Leader (FTL)	CH2M HILL	(865) 560-2983	David.seed@ch2m.com
Keith Dobson	Site Safety Coordinator (SSC)	CH2M HILL	(865) 560-2983	Keith.dobson@ch2m.com
Anita Dodson	Navy Program Chemist	CH2M HILL	(757) 671-6218	anita.dodson@ch2m.com
Bianca Kleist	Project Chemist	CH2M HILL	(704) 543-3274	bianca.kleist@ch2m.com
Troy Horn	Project Data Manager	CH2M HILL	(757) 671-6288	troy.horn@ch2m.com
Ronnie Wambles	Laboratory PM	ENCO Laboratories	(407) 826-5314	rwambles@encolabs.com
Lori Mangram	Laboratory QAO	ENCO Laboratories	(407) 826-5314	lmangrum@encolabs.com
Ann Skradski	Laboratory PM	GEL Laboratories	(843)-556-8171	ann.skradski@gel.com
Robert Pullano	Laboratory QAO	GEL Laboratories	(843)-556-8171	bob.pullano@gel.com
Nancy Weaver	Data Validator	Environmental Data Services	(757) 564-0090	nwaeaver@env-data.com

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SAP Worksheet #4: Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number	Signature/ email receipt	SAP Section Reviewed	Date SAP Read
Charity Rychak	MCB Camp Lejeune/ EMD	(910) 451-9386			
Matt Louth	CH2M HILL/ AM	(757) 671-6240			
Paul Favara	CH2M HILL / Navy CLEAN Program UFP-SAP Reviewer	(352) 384-7067			
Teg Williams	CH2M HILL/ Senior Technical Consultant	(704) 543-3297			
Keith LaTorre	CH2M HILL/PM	(865) 769-3204			
Lael Feist	CH2M HILL/Task Manager	(256) 529-7671			
Roni Warren	CH2M HILL/ HHRA	(814) 364-2454			
Jonathon Weier	CH2M HILL/ ERA	(770) 485-7503			
Carl Woods	CH2M HILL/ H&S Manager	(513) 889-5771			
Anita Dodson	CH2M HILL / Navy CLEAN Program Chemist	(757) 671-6218			
Bianca Kleist	CH2M HILL / Project Chemist	(704) 543-3274			
Troy Horn	CH2M HILL/ Project Data Manager	(757) 671-6288			
Ronnie Wambles	ENCO/PM	(407) 826-5314			
Lori Mangram	ENCO/QAO	(407) 826-5314			
Ann Skradski	GEL/ PM	(843) 556-8171			
Robert Pullano	GEL/QAO	(843) 556-8171			
Nancy Weaver	EDS / Validator	(757) 564-0090			

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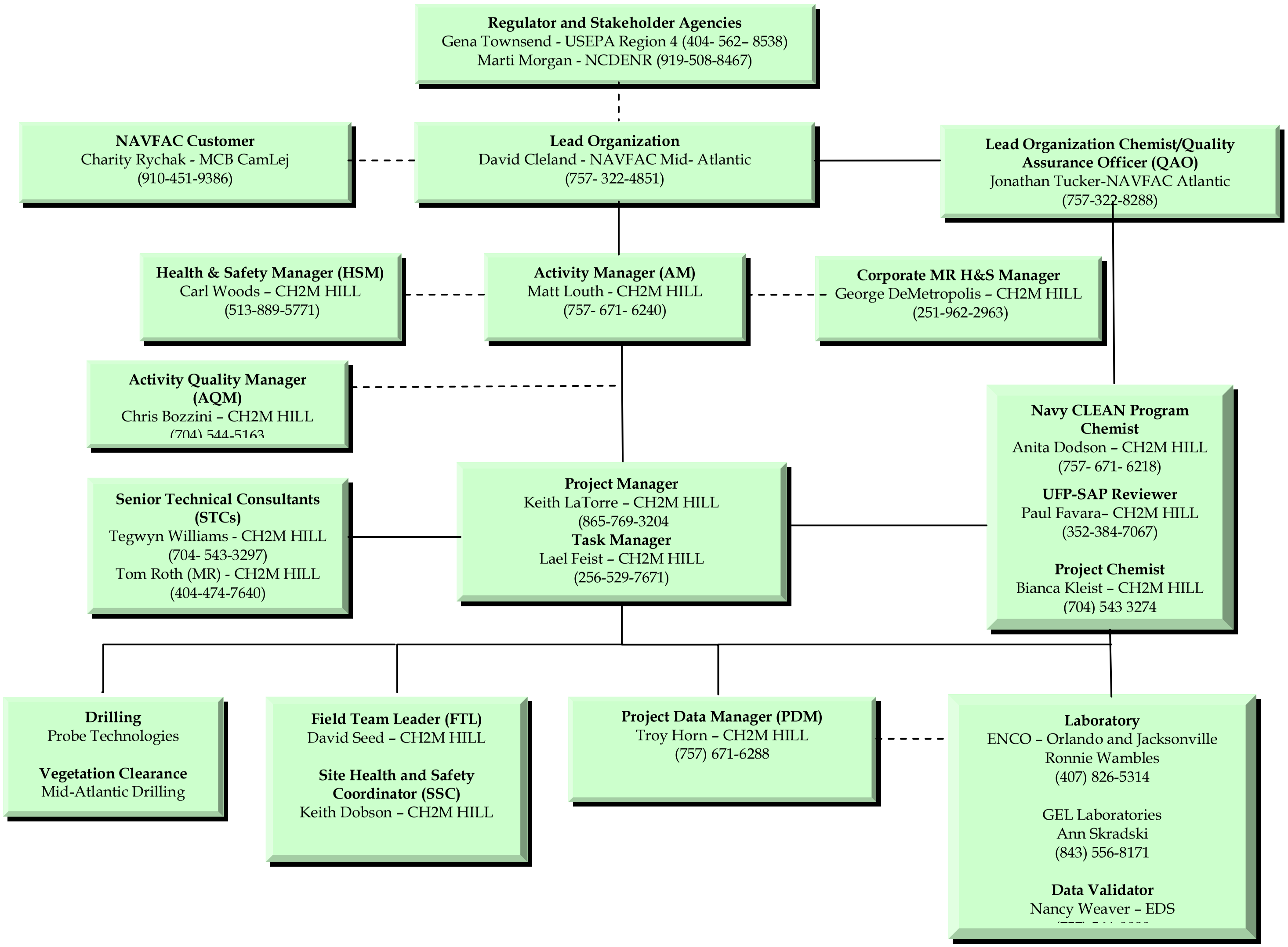
SAP Worksheet #5: Project Organizational Chart



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SAP Worksheet #6: Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
Communication with Navy (lead agency)	Navy NTR/RPM	Dave Cleland	david.t.cleland@navy.mil (757) 322-4851	Primary point of contact (POC) for Navy; can delegate communication to other internal or external POCs. RPM will notify USEPA and NCDENR via email or telephone call within 24 hours for field changes effecting the scope or implementation of the design occur. Navy will have 30 days for work plan review. All sampling data will be presented and discussed during partnering meetings.
Communication with USEPA Region 4	USEPA Region 4 RPM	Gena Townsend	townsend.gena@epa.gov (404) 562-8538	Primary POC for USEPA; can delegate communication to other internal or external POCs. Upon notification of field changes, USEPA will have 24 hours to approve or comment on the field changes. All data results will be presented and discussed during partnering meetings
Communication with NCDENR	NCDENR RPM	Marti Morgan	martha.morgan@ncdenr.gov (919) 508-8447	Project POC for NCDENR; can delegate communication to other internal or external POCs. Upon notification of field changes, NCDENR will have 24 hours to approve or comment on the field changes.
Communication regarding overall project status and implementation and primary POC with Navy RPM, USEPA, and NCDENR	CH2M HILL AM	Matt Louth	matt.louth@ch2m.com (757) 671-6240	Oversees project and will be informed of project status by the PM. If field changes occur AM will work with the Navy RPM to communicate in field changes to the team via email within 24hrs. All data results will be communicated to the project team during the first partnering meeting following data receipt.
Technical communications for project implementation, and data interpretation	CH2M HILL Senior Consultants	Tom Roth Teg Williams	tom.roth@ch2m.com (404)-474-7640 tegwyn.williams@ch2m.com (704-543-3297)	Contact senior consultant regarding questions/issues encountered in the field, input on data interpretation, as needed. Sr. Consultants will have 24 hrs to respond to technical field questions as necessary. Additionally, Sr. consultants will review of the data as necessary prior to partnering team discussion and reporting review.
Quality issues during project implementation and data interpretation	CH2M HILL AQM	Chris Bozzini	chris.bozzini@ch2m.com (704-544-5163)	Contact the AQM regarding quality issues during project implementation. The AQM will report to the AM and the NAVFAC Mid-Atlantic QAO.

SAP Worksheet #6: Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
Communications regarding project management and implementation	PM	Keith LaTorre	keith.latorre@ch2m.com (865-769-3204)	All information and materials about the project will be forwarded to the Navy, AM, and Senior Consultants as necessary. POC for field sampling team.
Coordinate activities between PM and Field Team / Sub-contractors	Task Manager	Lael Feist	laelruth.feist@ch2m.com (256-529-7671)	All field team and reporting activities will be forwarded to PM for further dissemination if necessary. Responsible for field team members' and subcontractors adherence to work plan.
Health and Safety (H&S)	CH2M HILL SSC	Keith Dobson	keith.dobson@ch2m.com (865-560-2983)	Responsible for the adherence of team members to the site safety requirements described in the Health and Safety Plan (HSP). Will report H&S incidents and near losses to PM.
Work Plan or QAPP changes in field/ Field Progress Reports	FTL	David Seed Kristin Rogers	David.seed@ch2m.com (919-760-1770) Kristin.rogers@ch2m.com (919-760-1789)	Documentation of deviations from the Work Plan will be made in the field logbook (made with the approval of AM and/or QAO) and the PM will be notified immediately. Provide daily progress reports to PM. Deviations will be made only with approval from the PM.
Communication regarding risk assessments	Human Health and Ecological Risk Assessors	Roni Warren (Human Health) Jonathan Weier (Ecological)	roni.warren@ch2m.com (814) 364-2454 jonathon.weier@ch2m.com (770) 485-7503	Responsible for conducting risk assessments. Technical questions regarding this project must be answered within 24 hours.
Data tracking from field collection to database upload	PDM	Troy Horn	troy.horn@ch2m.com (757) 671-6288	Tracking data from sample collection through database upload.
Reporting Lab Data Quality Issues	Laboratory QAO	Lori Mangrum (ENCO) and Robert Pullano (GEL)	lmangrum@encolabs.com (407) 826-5314 Bob.pullano@gel.com (834) 556-8171	All QA/quality control (QC) issues with project field samples will be reported within 2 days to the project chemist (PC) by the laboratory.
Reporting Data Validation (DV) Issues	DV PM	Nancy Weaver	dataqual@charter.net (314) 330-1327	All data validation issues regarding resubmissions from the laboratory will be communicated to the CH2M HILL project chemist and PDM.
Field and analytical corrective actions (CAs) Release of Analytical Data	Project Chemist	Bianca Kleist	bianca.kleist@ch2m.com (704) 543-3274	Any CAs for field and analytical issues will be determined by the FTL and/or the PC and reported to the PM within 4 hours. No analytical data can be released until validation of the data is completed and has been approved by the PC. The PC will review analytical results within 7 days of receipt for release to the project team.

SAP Worksheet #7: Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Dave Cleland	Navy Technical Representative	NAVFAC Mid-Atlantic	Oversees project
Charity Rychak	Environmental Engineer, Base Environmental Management Division	MCB Camp Lejeune	Oversees project
Gena Townsend	USEPA RPM	USEPA	USEPA POC
Marti Morgan	NCDENR RPM	NCDENR	NCDENR POC
Matt Louth, PG	Activity Manager	CH2M HILL	Oversees project activities
Chris Bozzini	Activity Quality Manager	CH2M HILL	Oversees project quality
Paul Favara	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Navy CLEAN Program UFP-SAP Reviewer
Tom Roth, PE	Activity Quality Manager	CH2M HILL	Provides senior MR technical support for remedial action design and implementation
Tim Garretson	Senior Technical Consultant (Munitions Response)	CH2M HILL	Provides senior MR technical support for munitions and explosives of concern (MEC)
Tegwyn Williams, PG	Senior Technical Consultant	CH2M HILL	Provides senior technical support for field investigations and implementation
Carl Woods	H&S Manager	CH2M HILL	Prepares H&S Plan; manages H&S for all field activities
Keith LaTorre	Project Manager	CH2M HILL	Manages Project and coordinates project tasks and project staff
Lael Feist	Task Manager	CH2M HILL	Manages project tasks and coordinates between field Team and PM
David Seed	FTL	CH2M HILL	Coordinates all field activities and sampling/
Keith Dobson	Site Manager/SSC	CH2M HILL	Manages all subcontractor and field activities/ Oversees H&S for all field activities
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides UFP-SAP project delivery support, provides senior review of UPF-SAP prior to submittal to Navy, and performs data evaluation and QA oversight
Bianca Kleist	Project Chemist	CH2M HILL	Communicates with laboratory and data validator
Troy Horn	Project Data Manager	CH2M HILL	Data Management, manages sample tracking

SAP Worksheet #7: Personnel Responsibilities Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibilities
Ronnie Wambles	PM	ENCO	Manages sample tracking and maintains good communication with PC and PDM
Lori Mangrum	Laboratory QA Officer	ENCO	Responsible for audits, CA, checks of QA performance within the laboratory
Ann Skradski	PM	GEL	Manages sample tracking and maintains good communication with PC and PDM
Robert Pullano	Laboratory QA Officer	GEL	Responsible for audits, CA, checks of QA performance within the laboratory
Nancy Weaver	DV	EDS	Validate data received from laboratory prior to data use

SAP Worksheet #8: Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
UXO Safety	UXO Safety (unexploded ordnance) Training Package	Registered training CH2M HILL online (UXO Safety-USAF)	Annually	PM and all field staff	FTL, field team members / CH2M HILL	CH2M HILL HSE

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

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SAP Worksheet #9: Project Scoping Session Participants Sheet

Project Name: CTO-WE41 Intrusive Investigation of Site UXO-11 and Site UXO-17

Projected Date(s) of Sampling: July-August 2011 | **Site Name:** Camp Lejeune

PM: Keith LaTorre | **Site Location:** Camp Lejeune, Jacksonville, North Carolina

Dates of Session: May 19, 2011

Scoping Session Purpose: The purpose of the scoping session was to present a summary of Site UXO-11 and UXO-17 Preliminary Assessment/Site Inspection and expanded Site Inspection results to the Camp Lejeune Project Team and to reach a consensus on the project approach for additional environmental sampling and intrusive investigation.

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
Marti Morgan	RPM	NCDENR	919- 508-8447	martha.morgan@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
Chris Bozzini	Camp Lejeune Quality Activity Manager	CH2M HILL	704-544-5163	chris.bozzini@ch2m.com	Activity Quality Manager for Camp Lejeune projects

Comments/Decisions:

Consensus: The Team will receive and comment on work plans associated with Sites UXO-11 and UXO-17. The partnering team requested additional environmental sampling at Site UXO-11 because explosives residues were detected in surface and subsurface soil, surface water and groundwater, and chromium was detected above screening levels in surface and subsurface soil, sediment, and groundwater. The partnering team requested groundwater well installation and sampling at Site UXO-17, to evaluate whether groundwater has been impacted by a liquid slurry filled drum discovered 4/25/11 during the intrusive investigation in the interior 4-acre portion of the site.

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

Consensus Decisions: The Team agreed that the general approach for investigating UXO-11 and UXO-17 is acceptable.

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SAP Worksheet #10-1: Conceptual Site Model- Site UXO-11

The objective of this SAP is to guide the assessment of potential environmental impacts related to explosives residues and chromium resulting from munitions use within Site UXO-11 and to evaluate whether potential impacts warrant further assessment at Site UXO-11. This objective will be addressed by sampling and analysis of environmental media for explosives residues (including nitroglycerin and pentaerythritol tetranitrate [PETN]), perchlorate, chromium, and hexavalent chromium, followed by human health and ecological risk screening (ERS).

Site Description

Site UXO-11 is a 2-acre area located north of Sixth Street and east of Seventh Street and the Marine Corps Air Station New River (**Figure 10-1**). The site is undeveloped and covered with landscaped grass. No historical structures or remnants of a practice hand grenade course are present. Current use of Site UXO-11 includes weekly athletic training exercises and occasional graduation ceremonies.

Site History

CH2M HILL HILL completed an Archival Records Search Report for this site as part of the Preliminary Assessment/Site Inspection (PA/SI) (CH2M HILL, 2011a). Historical range overlay maps show Site UXO-11 first appearing as a practice hand grenade course in 1954 (USACE, 2001). This document also references a map from September 1, 1953 and states that while the range appeared on the 1954 range overlay map, Site UXO-11 was in use only during 1953. To date, no other historical reference to this area being used as a practice hand grenade course has been identified. Existing conditions maps from 1947 and 1953 include the area designated as Site UXO-11. These maps show a mockup structure (Building 507), presumably used for training exercises, within the site boundaries. This building is also seen on aerial photographs from 1946, 1948, and 1951. Building 507 does not appear on maps after 1953. All aerial photographs from 1946, 1948, 1951, 1962, and 1989 show that the area designated as Site UXO-11 was clear of all vegetation except grass.

Previous Site Investigations

A PA/SI was conducted in 2009 for Site UXO-11 to evaluate the potential presence and nature of impacts to environmental media resulting from historical munitions use at the site, and to determine whether additional investigation and/or remediation activities were necessary. The May 2009 digital geophysical mapping (DGM) survey covered approximately 11.5 percent (approximately 0.23 acre) of Site UXO-11. The DGM survey, which utilized a single-coil EM61-MK2 system, resulted in the selection of 70 anomalies representing potential subsurface MEC.

Environmental sampling for MC analysis within Site UXO-11 consisted of:

- Twelve surface soil samples (0 to 2 inches bgs) collected from four DUs using the incremental sampling technique
- Five subsurface soil samples from soil cores collected using a direct push technology (DPT) rig

SAP Worksheet #10-1: Conceptual Site Model- Site UXO-11 (continued)

- Two sediment and two surface water samples each were collected at co-located sites from the unnamed drainage swale in the southeastern portion of the site
- One groundwater sample was collected from each of the five temporary well locations

Samples were analyzed for explosives residues, including PETN and nitroglycerin, perchlorate, and target analyte list (TAL) metals. Surface water and groundwater samples were additionally analyzed for dissolved metals.

Explosives residues and metals were detected in site media and compared to applicable screening criteria, resulting in the following exceedances:

- Surface soil - nitroglycerin, arsenic, and chromium
- Subsurface soil - aluminum, arsenic chromium, and iron
- Sediment - Aluminum, arsenic, and chromium exceeded one or more comparison criteria
- Groundwater - nitrobenzene, arsenic, chromium, and cobalt

The preliminary human health risk screening (HHRS) indicated that potential contact with sediment and potable use of groundwater by current and future receptors could result in carcinogenic risks greater than the target level (primarily associated with chromium). Sediment and groundwater were both evaluated using screening values for hexavalent chromium, the more toxic (and carcinogenic) form of chromium for human receptors, and assuming residential type exposures to both media.

The HHRS determined that if the shallow groundwater for the area were used as a residential potable water supply, there could be unacceptable risks associated with the chromium detected in groundwater. However, this was primarily associated with the assumption that all of the chromium detected in the groundwater is in the hexavalent form, which is unlikely, as discussed in the PA/SI. It should also be noted that the shallow groundwater is not currently used as a potable water supply at Site UXO-11 or MCB CamLej, and it is unlikely that it would be in the future. The HHRS evaluated the more likely exposure scenario, exposure to the shallow groundwater by construction workers during excavation activities. Because the exposure to groundwater for a construction worker is much lower than that for residential potable use, the risk to the construction worker would be within acceptable risk levels. The ERS indicated that there were no unacceptable risks to environmental receptors from exposure to site media.

Based on the DGM results, the draft report recommended that an intrusive investigation be performed to assess the nature of the identified geophysical anomalies.

Conceptual Site Model- Site UXO-11

A conceptual site model (CSM) is critical to the development of an investigation strategy. The following sections describe the site features, potential source areas and release mechanisms, and their relationship with surrounding environmental media and receptors. A hypothetical three-dimensional CSM for generic UXO sites is provided as **Figure 10-2**.

SAP Worksheet #10-1: Conceptual Site Model- Site UXO-11 (continued)

Physical Characteristics

The site is undeveloped, but covered with landscaped grass. The site gently slopes southwest towards Sixth and Seventh Streets. There is little topographic relief at the site, with elevations ranging from approximately 18 to 19 feet above mean sea level. A small drainage swale is located in the southeast corner of the site and several other drainage swales surround the site. The drainage swale on the southeast corner of the site drains southwest towards the traffic circle.

Active supply well PSWTC-600 is approximately 800 feet (ft) from Site UXO-11. The well is screened from 48-70 ft below ground surface (ft bgs), in the Castle Hayne Aquifer, and runs at a rate of 100 gallons per minute (gpm) (AHEC, 2002). The MCB CamLej Wellhead Protection Plan (AHEC, 2002) cites that the cone of influence created from this well pumping at 100 gpm for 10 years, extends under Site UXO-11.

Site UXO-11 is underlain by laterally discontinuous clay and silt to very fine to fine-grained sands of the surficial aquifer up to 15 ft bgs based on description of PA/SI soil cores.

Site-specific hydrogeologic information was also derived from the installation of five shallow temporary monitoring wells screened above the Castle Hayne confining unit in the undifferentiated surficial aquifer, as detailed in the PA/SI. The temporary well depths for Site UXO-11 ranged from 12 to 15 ft bgs. In December 2009, groundwater flow was toward the center of the site at a horizontal hydraulic gradient of approximately 0.02 ft/ft.

Surface water from Site UXO-11 flows to an unnamed tributary of Edwards Creek and then into the New River. The New River flows into the Atlantic Ocean via New River inlet (MCB CamLej, 2002).

Potential Sources of Release

Intact, expended, or discarded practice hand grenades may be a potential source of MCs. These munitions items may be on the surface or near surface of the site.

Fate and Transport

MCs may be present on the surface and in the shallow subsurface and could potentially release into surface water (when present) and underlying sediments. The explosives residue nitroglycerin was present in soil at concentrations greater than screening criteria and chromium was present in soil and sediments concentrations greater than screening criteria. MCs could be transported by erosional forces (surface water runoff and wind) to drainage features on and offsite (e.g., wetlands) and deposited as sediments.

MCs may also be present and transported in groundwater in the surficial aquifer. The explosive residue nitrobenzene and chromium were identified in groundwater above screening criteria.

Conceptual Site Model- Site UXO-11 (continued)

Potential Receptors

The potential receptors for Site UXO-11 include: visitors, trespassers, Base/industrial workers, and maintenance workers. The current receptors may come in contact with surface soil, surface water, and sediment. Exposure routes may include incidental ingestion of and dermal contact with the surface soil, surface water, and sediment, and inhalation of particulate emissions from the surface soil.

Potable water supplies for MCB CamLej and the surrounding residential area are provided by water supply wells that pump groundwater from the Castle Hayne Aquifer; as a result, there are no current receptors to shallow groundwater at Site UXO-11. There is an active water supply well within 1,500 feet of the site, screened from 48-70 ft below ground surface. However, this well is screened in the Castle Hayne aquifer, not the surficial aquifer. The groundwater use patterns are already established for the Base and area around Site UXO-11, so use of shallow groundwater from Site UXO-11 for industrial or residential purposes is unlikely. Additionally, the surficial aquifer at MCB CamLej is not suitable for potable water use due to high dissolved solids and hardness levels and fluctuating water levels that negatively affect water yields. Base/industrial workers and maintenance workers could come into contact with groundwater, if construction were to occur at the site in the future.

Problem Definition

Although no unacceptable human health or ecological risks were identified from exposure to site media during the site PA/SI, additional environmental sampling is necessary to characterize explosives residues and chromium. Explosives residues were detected in all media except sediment. The explosives residues nitroglycerin and nitrobenzene exceeded screening criteria in surface soil and groundwater, respectively. Discrete grab samples would provide better delineation of the extent of impact by explosives residues. Chromium was detected above screening values in all media. Speciation of chromium would indicate whether chromium was present onsite as hexavalent chromium, the most toxic form.

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

1. **Have there been releases of MCs to soil?** This question will be addressed by collecting 20 surface and 20 subsurface soil samples as shown on **Figure 10-3**. Surface soil samples will be collected as grab samples; whereas subsurface soil samples will be collected by hand auger, from unsaturated soil immediately above the water table (estimated at 5 feet bgs). Soil samples will be analyzed for explosives residues (including nitroglycerin and PETN), perchlorate, chromium, and hexavalent chromium.

2. **Have there been releases of MCs to sediment?** This question will be addressed by collecting two sediment samples from the unnamed drainage swale in the southeastern portion of the site, as shown on **Figure 10-4**. Sediment samples will be analyzed for explosives residues (including nitroglycerin and PETN), perchlorate, chromium, and hexavalent chromium.

SAP Worksheet #10-1: Conceptual Site Model –Site UXO-11 (continued)

3. **Have there been releases of MCs to surface water?** This question will be addressed by collecting two surface water samples from the unnamed drainage swale in the southeastern portion of the site, as shown on **Figure 10-4.** Samples will be collected first from the downstream location and then the upstream location. If no surface water is present at the planned locations, the samples will be collected from the nearest available surface water within the drainage swale. Surface water samples will be analyzed for explosives residues (including nitroglycerin and PETN), perchlorate, total chromium, dissolved chromium, total hexavalent chromium and dissolved hexavalent chromium.

4. **Have there been releases of MCs to groundwater?** This question will be addressed by collecting and analyzing groundwater samples from five new permanent monitoring wells screened within the surficial aquifer. The five new monitoring wells will be constructed at the locations shown on **Figure 10-4** to evaluate transport of potential MCs on and offsite. Groundwater samples will be analyzed for explosives residues (including nitroglycerin and PETN), perchlorate, total chromium, dissolved chromium, total hexavalent chromium, and dissolved hexavalent chromium.

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

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

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

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-17

The objective of this SAP is to guide the assessment of potential environmental impacts to groundwater related to a liquid slurry fillied 55-gallon drum containing an unknown substance. This objective will be addressed by installation of temporary monitoring wells and groundwater sampling and analysis of VOCs and SVOCs from new and existing wells.

Site Description

Site UXO-17 is approximately 16 acres in area and is located east of Piney Green Road and north of the current base landfill (**Figure 10-5**). This site is accessible from Old Bear Creek Road, which crosses the southern portion of the investigation area. In addition, a fence associated with the Base landfill is located in the southeast portion of Site UXO-17.

The site is located approximately 23 feet above msl. The site topography gently slopes to the southeast, with little relief besides manmade earthen mounds and "foxholes". Construction debris is found in piles and pits onsite. Surface water runoff at Site UXO-17 flows into localized drainage ditches which in turn drain to Wallace Creek. Surface water also ponds in the south-central portion of the site. Portions of the site have been cleared of vegetation for SI activities.

Site History

Site UXO-17 (ASR#2.212) was reportedly used as a firing position from the 1950s through at least 1985. 105-mm and 155-mm howitzers were used at this site to fire practice rounds into the K-2 and G-10 Impact Areas (CH2M HILL, 2010c). In addition, 4.2-inch mortars, 175-mm guns, 8-inch howitzers, and 120-mm mortars also may have been fired from this location, with unused projectile propellant being burnt on the ground. No CWM was reported to have been used at this site. Based on concrete, metal drums, and other scrap metal encountered during intrusive investigation, the site has also been used for disposal of construction debris.

Previous Investigations

2008 Focused PA/SI

A focused PA/SI was conducted in September and October 2008 over the central 4-acres of Site UXO-17 that included DGM and environmental sampling. DGM was conducted over the entire 4-acre portion of the site using an EM61-MK2A, with the exception of areas that could not be accessed due to irregular terrain, dense trees, or construction debris. A total of 1,310 anomalies and 21 saturated response areas with a signal greater than 3 millivolts (mV) were identified from the DGM data as representing potential subsurface MEC. A saturated response area is where a subsurface anomaly or multiple subsurface anomalies are present for which the signal is so strong that one cannot distinguish between individual anomalies. Reinforced concrete, metallic debris, and soil mounds were observed on the ground surface throughout a high anomaly concentration area.

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-17 (continued)

Sampling during the focused PA/SI included collection of:

- Three composite surface soil samples from each of three 40 m × 70 m decision units
- Four subsurface soil samples at depths ranging from 3 to 7 feet bgs
- Four groundwater samples from temporary monitoring wells installed during the focused PA/SI.

All samples were analyzed for explosives residues, perchlorate, and total TAL metals. Chromium in groundwater samples was the only metal that exceeded both Base background concentrations and regulatory screening criteria.

A HHRS including a risk ratio evaluation was performed based on surface soil, subsurface soil, and groundwater analytical results. Results of the HHRS indicate that there are no unacceptable risks identified for current or likely future receptors exposed to site media. An ERS was performed based on surface soil and groundwater analytical results. Results of the ERS indicate that there are no unacceptable risks identified for ecological receptors exposed to site media.

Based on the results of the HHRS and ERS, no further evaluation of surface soil, subsurface soil, and groundwater was recommended within the 4-acre Focused PA/SI investigation area (CH2M HILL, 2010d).

Based on the DGM results, an intrusive investigation of the anomalies identified within the Focused PA/SI investigation area was recommended to assess the nature of the sources of the identified anomalies. An evaluation of the presence and nature of any subsurface anomalies and MC contamination that may exist was also recommended for the surrounding 12 acres of Site UXO-17, to complete a site-wide PA/SI.

2010 Expanded PA/SI

Additional DGM and environmental sampling field activities were completed over the remaining 12 acres of Site UXO-17 in November and December 2010 as a continuation of the PA/SI.

Approximately 9% of the 12-acre portion of the site was geophysically mapped using an EM61-MK2 system. A total of 656 anomalies greater than 3 mV were identified as representing potential subsurface MEC (CH2M HILL, 2010c). Metal and reinforced concrete debris was observed at multiple locations and may constitute a portion of the selected anomalies.

Environmental sampling within the 12-acre portion of Site UXO-17 consisted of:

- Three surface soil samples each collected from three 30m × 30m DUs at depths of 0 to 2 inches bgs using incremental sampling.
- Nineteen surface soil samples were collected using the TR-02-1 sampling method from a depth of 0 to 2 inches bgs.

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-17 (continued)

- Ten subsurface soil samples from soil cores collected using a DPT rig
- One sediment and one surface water sample collected from a co-located site.
- Seven groundwater samples collected from temporary groundwater monitoring wells

Soil and sediment samples were analyzed for explosives residues (including PETN and nitroglycerin), perchlorate, and TAL metals. Surface water and groundwater samples were analyzed for explosives residues, total TAL metals and dissolved metals; three groundwater samples were analyzed additionally for total chromium and hexavalent chromium.

In collected surface soil samples:

- Arsenic, chromium, cobalt, iron, and manganese were detected at concentrations greater than twice the Base background values and at least one regulatory screening level.

In collected subsurface soil samples:

- Aluminum, arsenic, chromium and iron were detected at concentrations greater than twice the Base background values and at least one regulatory screening level.

In the collected sediment sample:

- Aluminum, arsenic, and chromium were detected at concentrations greater than at least one regulatory screening level in the sample.

In collected groundwater samples:

- Chromium, cobalt, potassium, and dissolved potassium were detected at concentrations exceeding Base background groundwater concentrations and at least one regulatory screening criterion.

Human health and ERS did not identify any unacceptable risks for human or ecological receptors from any media in the investigation area and further investigation of Site UXO-17 for MCs was not recommended. For the 12-acre portion of the site, it was recommended that the anomalies selected as representing potential subsurface MEC be intrusively investigated.

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-17 (continued)

2011 Expanded SI

An Expanded SI for UXO-17 was performed in 2011 that included intrusive investigation of 1,310 anomalies and 21 saturated response areas in the 4-acre portion of the site (all target anomalies and saturated response areas identified in the 4-acre portion of the site during the PA/SI) and 70 anomalies in the in the 12-acre portion of the site (approximately 10% of the target anomalies identified in the 2010 Expanded PA/SI). Of the investigated anomalies, 38 were determined to be "no contact" (i.e. the source of the anomalies was not identified).

On March 29, 2011, a single MEC item, a ¼ lb supplemental charge, determined to be a discarded military munitions (DMM) item, was found within a saturated response area in the 4-acre portion of the site. The item was blown-in-place on March 30, 2011. Three post-detonation soil samples were collected and indicated no unacceptable risk to human or ecological receptors. MPPEH items encountered included 5.56mm and 7.62mm blank ammunition and practice land mine parts. In addition more than 263,000 pounds of cultural items (including construction debris and scrap metal) were recovered.

During the intrusive investigation, a total of six 55-gallon metal drums were identified onsite. One of these drums was partially filled with soil and another drum was filled with a liquid slurry. Upon disturbance of the liquid slurry filled drum, liquid leaked onto the ground surface. A sample collected from its contents was found to contain detectable concentrations of metals (arsenic, barium, cadmium, chromium, and lead), VOCs (n-butylbenzene, sec-butylbenzene, iso-propylbenzene, p-isopropyltoluene, naphthalene, n-propylbenzene, 1,2,4-trichorobenzene, 1,3,5-trimethylbenzene, and o-xylene), and SVOCs(2,4-dimethylphenol, 1-methylnapthalene, 2-methylnapthalene). Impacted soil from the spill was containerized into 35 55-gallon drums and is currently awaiting analysis prior to disposal. The Partnering Team concurred that a shallow groundwater investigation should be conducted in the vicinity of the former location of the liquid slurry-filled drum.

Conceptual Site Model

The following sections describe the site features, potential source areas and release mechanisms, and their relationship with surrounding environmental media and receptors for Site UXO-17. A hypothetical three-dimensional CSM for generic UXO sites is provided as **Figure 10-2**.

Physical Characteristics

Former Firing Position 2 is located approximately 23 feet above msl. The site topography gently slopes to the southeast, with little relief besides manmade earthen mounds and pits. Surface water ponds in the south-central portion of the site. Surface water runoff in the northern part of the site ultimately flows into localized drainage ditches which in turn drain to Wallace Creek. Prior to investigation activities, approximately 60 percent of the site was wooded with the remainder of the site cleared of vegetation.

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-17 (continued)

Based on soil cores collected during the PA/SI, subsurface geology at the site consists of shallow deposits at the site consist of discontinuous layers of fine-grained sands to fine-grained silty sands and discontinuous layers of clay consistent with the undifferentiated formation. The water table was encountered at depths ranging from 3 to 11 feet bgs.

Site-specific hydrogeologic information was derived from the installation of four shallow temporary monitoring wells in the 4-acre portion of the site and seven shallow temporary monitoring wells in the 12-acre portion of the site during the PA/SI. The temporary well depths for Site UXO-17 ranged from 13 to 17 ft bgs which were screened above the Castle Hayne confining unit in the surficial aquifer. In December 2010, groundwater flow generally flowed toward the northeast, based on groundwater elevations measured in the 12-acre portion of the site.

Potential Sources of Release

Potential Sources of VOCs and/or SVOCs may include the leaking drum discovered during anomaly investigation in the 4-acre portion of the site, as shown on **Figure 10-6**.

Fate and Transport

VOCs and/or SVOCs may be present in shallow groundwater and could potentially release into offsite surface water bodies and underlying sediments.

Potential Receptors

The potential receptors for Site UXO-17 include: visitors, trespassers, Base/industrial workers, and maintenance workers. Current receptors may come in contact with surface soil. Exposure routes may include incidental ingestion of and dermal contact with the surface soil and inhalation of volatile and particulate emissions from the surface soil.

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

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-17 (continued)

Problem Definition

A 55-gallon drum filled with a liquid slurry containing metals, VOCs, and SVOCs was discovered in the 4-acre portion of the site during the expanded Site Inspection in April 2011. If one or more releases of VOCs or SVOCs have occurred to groundwater, it is unknown the nature and extent of area which presents potentially unacceptable risk to human health and/or ecological receptors; therefore, further assessment of groundwater is warranted.

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

1. **Have there been releases of VOCs or SVOCs to groundwater?** This question will be addressed by installing three new temporary monitoring wells near and immediately downgradient of location where the leaking 55-gallon drum was found. Eight groundwater samples will be collected from new and existing monitoring wells and submitted for laboratory analysis. Groundwater sampling locations are shown on **Figure 10-6**. Groundwater samples will be analyzed for VOCs and SVOCs.

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

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

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

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

This section presents the project quality objectives for the investigations at Site UXO-11 and UXO-17.

Who will use the data?

At Site UXO-11, the data will be used by the MCB CamLej project team to evaluate the extent of explosives residues and chromium impacts to surface and subsurface soil, sediment, surface water and groundwater potentially from munitions use. At site UXO-17, the data will be used to evaluate VOCs and SVOCs impacts to groundwater potentially resulting from drum disposal at the site. The data at both sites will be used to assess whether the potential releases warrant further assessment or action.

What are the project action limits?

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

<u>Site UXO-11</u>

Surface and Subsurface Soil

1. Surface and subsurface soil analytical results for metals will be compared to two times the mean base background concentrations for soil (Baker, 2002).

   Surface and subsurface soil analytical results also will be compared to the adjusted USEPA Regional Screening Levels (RSLs) for industrial and residential soil (USEPA, 2011). 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.

2. Surface and 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 (as defined above) USEPA soil RSLs are the established screening criteria for sediment at MCB CamLej.

Surface Water

1. Surface water analytical results will be compared to the North Carolina Administrative Code (NCAC) 2B surface water quality standards for human health and water supply, if available.

2. Concentrations of surface water constituents also will be compared to the Nationally Recommended Water Quality Criteria (NRWQC) for human health, if available.

3. If a NCAC 2B surface water standard 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 Partnering Team.

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

Site UXO-11 continued

Groundwater

1. In accordance with policy developed by the Project Team, groundwater analytical results for metals will be compared to two times the mean base background concentrations (Baker, 2002).
2. Groundwater analytical results will be compared to NCAC 2L Groundwater Quality Standards (NCGWQS) (NCDENR, 2010b).
3. If a standard for a substance is less than the laboratory practical quantitation limit, the detection of that substance at or above the practical quantitation limit shall constitute a violation of the NCGWQS. The practical quantitation limit for this project is set at the laboratory limit of quantitation (LOQ).
4. Groundwater analytical results also will be compared to the adjusted (as defined above) USEPA RSLs for tap water (USEPA, 2011) and drinking water maximum contaminant levels (MCLs).

Site UXO-17

Groundwater

1. In accordance with policy developed by the Project Team, groundwater analytical results for metals will be compared to two times the mean base background concentrations (Baker, 2002).
2. Groundwater analytical results will be compared to NCGWQS.
   - If a standard for a substance is less than the laboratory practical quantitation limit, the detection of that substance at or above the practical quantitation limit shall constitute a violation of the NCGWQS. The practical quantitation limit for this project is set at the laboratory limit of quantitation (LOQ).
3. Groundwater analytical results also will be compared to the adjusted (as defined above) USEPA RSLs for tap water (USEPA, 2011) and drinking water MCLs.

What will the data be used for? The data will be used to perform human health screening and ecological risk assessments and evaluate: the nature of any contamination, its significance of release, if releases took place, and if so, whether further assessment or interim action is warranted.

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

What types of data are needed?

- Worksheet #10-1 and Worksheet #10-2 define the sample media and target analyte list to be used during this investigation of Site UXO-11 and Site UXO-17, respectively. Since explosives residues were detected in surface and subsurface soil, surface water, and groundwater and total chromium was detected above screening levels in surface and subsurface soil, sediment, and groundwater, the target analytes list for Site UXO-11 includes explosives residues (including PETN and nitroglycerin), perchlorate, total chromium, and hexavalent chromium. Surface water and groundwater samples will additionally be analyzed for dissolved chromium and dissolved hexavalent chromium. The analytical results will provide additional information regarding the distribution and concentrations of explosives residues and the speciation of chromium in environmental media onsite. At Site UXO-17, a buried leaking drum was found onsite in April 2011 that contained metals, VOCs, and SVOCs. Groundwater will be sampled for VOCs and SVOCs. The analytical results will provide data regarding potential impacts to groundwater.
- Water quality parameters, including field testing for pH, conductivity, oxidation-redution potential (ORP), dissolved oxygen (DO), temperature, and turbidity, will be measured during the purging of the monitoring wells and sampling of groundwater.
- 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 CSMs for each site.
- Surface and subsurface soil and sediment sample locations will be recorded by hand-held global positioning system (GPS) devices during environmental sampling activities. Following sample collection, monitoring well locations and elevations will be surveyed by a NC-licensed surveyor. Field activities will be recorded in a field notebook to document adherence to the approved work plan. The CH2M HILL “Preparing Field Log Books SOP” located in **Attachment 2** describes the documentation required for log book completion.

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

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

- Laboratory analytical data will be distributed to a third-party validator for data quality evaluation. Data validation procedure requirements are detailed in Worksheet #36. The data needs to be of sufficient quality for determining the concentration of constituents in media samples such that the project objectives can be achieved.
- Visual observations (soil saturation, staining etc.) will be used to determine appropriate well screen placement for groundwater sampling at Site UXO-11 and UXO-17 and to help select subsurface soil sampling intervals at Site UXO-11.
- 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**).
- 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 investigation, QA/QC samples will be collected along with the various media samples as a check on sampling and analytical protocol. Worksheet #20 describes the QA/QC quantities and analyses for this UFP-SAP.

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

How much data should be collected?

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

    - UXO-11 Surface and Subsurface Soil: 20 surface soil samples and 20 subsurface samples are proposed for collection and subsequent analysis for explosives residues (including nitroglycerin and PETN), perchlorate, chromium, and hexavalent chromium analysis.
    - UXO-11 Sediment: two sediment samples are proposed for collection and subsequent analysis for explosives residues (including nitroglycerin and PETN), perchlorate, chromium, and hexavalent chromium analysis.
    - UXO-11 Surface Water: two surface water samples are proposed for collection and subsequent analysis for explosives residues (including nitroglycerin and PETN), perchlorate, total and dissolved chromium, and total and dissolved hexavalent chromium.
    - UXO-11 Groundwater: five groundwater samples are proposed for collection and subsequent analysis for explosives residues (including nitroglycerin and PETN), perchlorate, and total and dissolved chromium, total and dissolved hexavalent chromium.
    - UXO-17 Groundwater: a total of eight samples will be collected from monitoring wells (3 newly installed and 5 existing) and subsequently analyzed for VOCs and SVOCs.

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

- The environmental samples will be collected within and nearby site boundaries as shown on **Figures 10-3** and **10-4** (Site UXO-11) and **Figure 10-6** (Site UXO-17).
- The proposed investigation will be conducted in July-August 2011.
- The environmental samples will be collected in accordance with the SOPs presented in Worksheet #21.

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

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

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

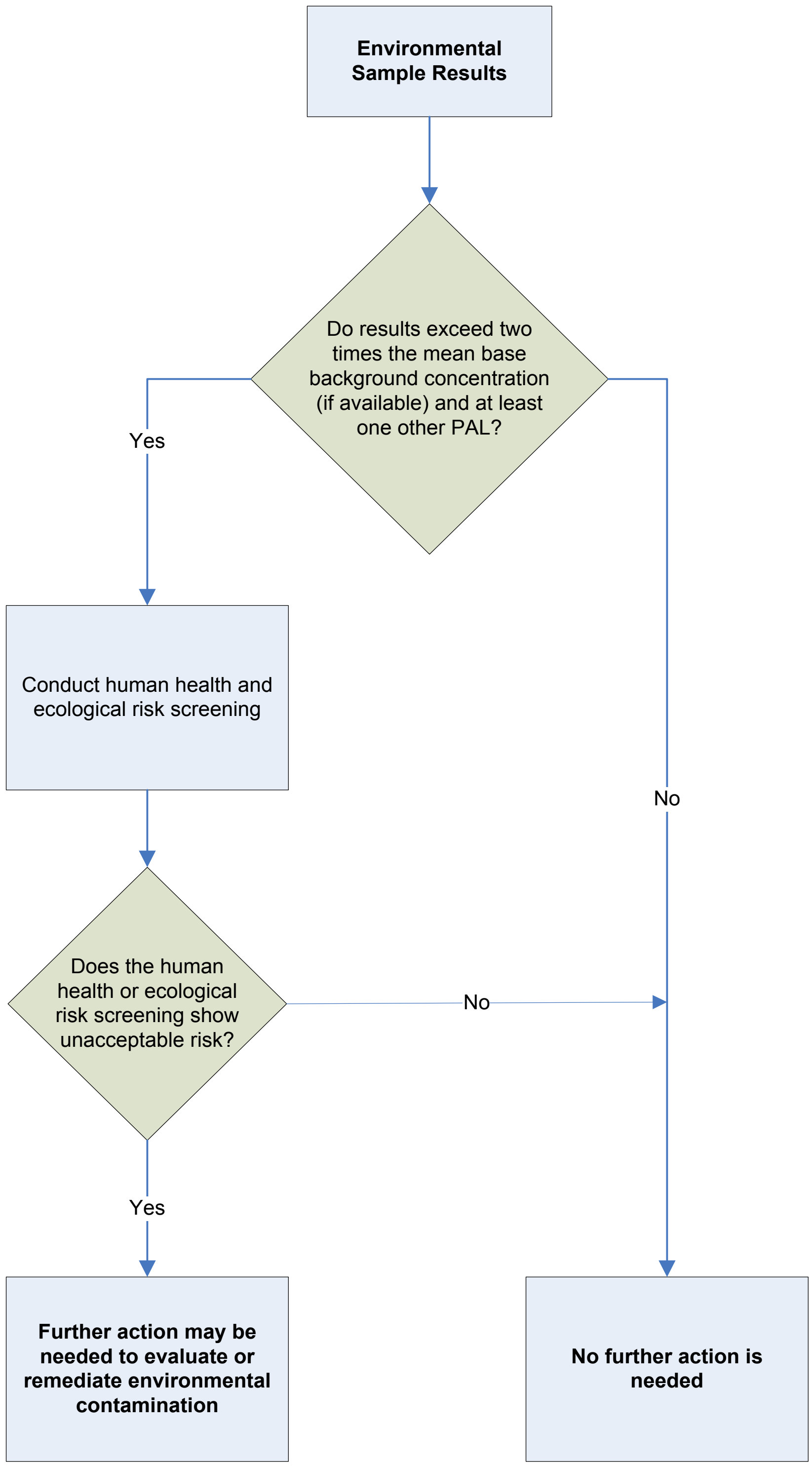
How will the data be archived?

Data will be archived according to the Navy CLEAN program/contract requirements. Data will be uploaded into a centralized database Naval Installation Restoration Information Solution (NIRIS) maintained by CH2M HILL and used for Navy projects. At the end of the project, paper copies of archived laboratory data and validation reports will be returned to the Navy.

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

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

Figure 11-1
Project Quality Objectives Decision Flow Chart:
Contract Task Order WE41- Sites UXO-11 and UXO-17
MCB CamLej



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SAP Worksheet #12-1A: Field Quality Control Samples- Site UXO-11

Matrix: Surface Soil, Surface Soil, Sediment[1]

Analytical Group: Explosives

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Explosives	One per 10 field samples	Precision	RPD ≤30%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 degrees Celsius (°C)	S

[1] Surface soil, subsurface soil and sediment will each have their own associated field QC.

SAP Worksheet #12-1B: Field Quality Control Samples- Site UXO-11

Matrix: Surface Soil, Surface Soil, Sediment[1]

Analytical Group: Perchlorate

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Perchlorate	One per 10 field samples	Precision	RPD ≤15%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

[1] Surface soil, subsurface soil and sediment will each have their own associated field QC.

SAP Worksheet #12-1C: Field Quality Control Samples- Site UXO-11

Matrix: Surface Soil, Surface Soil, Sediment[1]

Analytical Group: Chromium

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)
Field Duplicate	Chromium	One per 10 field samples	Precision	RPD ≤20%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

[1] Surface soil, subsurface soil and sediment will each have their own associated field QC.

SAP Worksheet #12-1D: Field Quality Control Samples- Site UXO-11

Matrix: Surface Soil, Subsurface Soil, Sediment[1]

Analytical Group: Hexavalent Chromium

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Hexavalent Chromium	One per 10 field samples	Precision	RPD ≤30%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

[1] Surface soil, subsurface soil and sediment will each have their own associated field QC.

SAP Worksheet #12-1E: Field Quality Control Samples- Site UXO-11

Matrix: Surface Water, Groundwater

Analytical Group: Explosives

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Explosives	One per 10 field samples	Precision	RPD ≤30%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank[2]		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 degrees Celsius (°C)	S

[1] Surface water and groundwater will each have their own associated field QC.

[2] Surface water samples will be collected in the clean bottleware provided by the laboratory; no equipment blank will be collected.

SAP Worksheet #12-1F: Field Quality Control Samples- Site UXO-11

Matrix: Surface Water, Groundwater [1]

Analytical Group: Perchlorate

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Perchlorate	One per 10 field samples	Precision	RPD ≤15%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank[2]		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

[1] Surface water and groundwater will each have their own associated field QC.

[2] Surface water samples will be collected in the clean bottleware provided by the laboratory; no equipment blank will be collected.

SAP Worksheet #12-1G: Field Quality Control Samples- Site UXO-11

Matrix: Surface Water, Groundwater[1]

Analytical Group: Chromium

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)
Field Duplicate	Chromium	One per 10 field samples	Precision	RPD ≤20%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank[2]		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

[1] Surface water and groundwater will each have their own associated field QC.

[2] Surface water samples will be collected in the clean bottleware provided by the laboratory; no equipment blank will be collected.

SAP Worksheet #12-1H: Field Quality Control Samples- Site UXO-11

Matrix: Surface Water, Groundwater[1]

Analytical Group: Hexavalent Chromium

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Hexavalent Chromium	One per 10 field samples	Precision	RPD ≤20%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank[2]		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

[1] Surface water and groundwater will each have their own associated field QC.

[2] Surface water samples will be collected in the clean bottleware provided by the laboratory; no equipment blank will be collected.

SAP Worksheet #12-2A: Field Quality Control Samples- Site UXO-17

Matrix: Groundwater

Analytical Group: VOCs

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)
Field Duplicate	VOCs	One per 10 field samples	Precision	RPD ≤30%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Trip Blank		One per cooler	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

SAP Worksheet #12-2B: Field Quality Control Samples- Site UXO-17

Matrix: Groundwater

Analytical Group: SVOCs

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)
Field Duplicate	SVOCs	One per 10 field samples	Precision	RPD ≤30%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Trip Blank		One per cooler	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	0-6 °C	S

SAP Worksheet #12-3A: Field Quality Control Samples- Sites UXO-11 & UXO-17 Post-Detonation Sampling

Matrix: Surface Soil Composite and Surface Soil Incremental[1]

Analytical Group: Explosives

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Explosives	One per 10 field samples	Precision	RPD ≤20%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 °C	S

[1]For Field Duplicates, surface soil composite and incremental samples will be treated as separate matrices.

SAP Worksheet #12-3B: Field Quality Control Samples- Sites UXO-11 & UXO-17 Post-Detonation Sampling

Matrix: Surface Soil Composite and Surface Soil Incremental[1]

Analytical Group: Perchlorate

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Perchlorate	One per 10 field samples	Precision	RPD ≤10%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 °C	S

[1]For Field Duplicates, surface soil composite and incremental samples will be treated as separate matrices.

SAP Worksheet #12-3C: Field Quality Control Samples- Sites UXO-11 & UXO-17 Post-Detonation Sampling

Matrix: Surface Soil Composite and Surface Soil Incremental[1]

Analytical Group: TAL Metals, including Mercury

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	TAL Metals, including Mercury	One per 10 field samples[1]	Precision	RPD ≤20%	S & A
Field Blank		One per week	Bias / Contamination	Same as Method Blank. Refer to **Worksheet #28**.	S & A
Equipment Rinseate Blank		One per day[2]	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

[1]For Field Duplicates, surface soil composite and incremental samples will be treated as separate matrices.

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SAP Worksheet #13: Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How The Data Will Be Used	Limitations on Data Use
Site UXO-11				
2011 Archival Report	CH2M HILL, *Archival Records Search Report for the Preliminary Assessment/Site Inspection of Site* UXO-11 , Former B-5 Practice Hand Grenade Course (ASR #2.81)	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 3-65 years old and may not be representative of current conditions
2011 PA/SI Report	CH2M HILL, Preliminary Assessment/Site Inspection Report MMRP Site UXO-11 , Former B-5 Practice Hand Grenade Course (ASR #2.81)	CH2M HILL DGM, soil, sediment surface water and groundwater data 2009	Planning and Sample Location Selection	Data is limited to total chromium, , explosives (including PETN and nitroglycerin), and perchlorate results were from composite surface soil samples
Site UXO-17				
2009 Archival Report	CH2M HILL, Archival Records Search Report for the Preliminary Assessment/Site Inspection of Site UXO-17, Former Firing Position #2 (ASR #2.12)	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 3-61 years old and may not be representative of current conditions
2011 PA/SI Report	CH2M HILL, Preliminary Assessment/Site Inspection Report MMRP Site UXO-14 Former Indoor Pistol Range(ASR #2.199) and Gas Chamber (ASR #2.200) (Rifle Range Area)	CH2M HILL. DGM, soil, sediment surface water and groundwater data 2010	Planning and Sample Location Selection	Data is limited to explosives residues (including nitroglycerin and PETN), perchlorate, and TAL metals analyses. Groundwater samples were potentially collected prior to a release from the leaking drum discovered in April 2011.

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SAP Worksheet #14: Summary of Project Tasks

Pre-Field Tasks

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

Field Tasks

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

Mobilization

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

General Activities

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

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

Kickoff/Safety Meeting

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

Land Surveying

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

Vegetation Clearance

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

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

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

Geospatial Information and Electronic Submittals

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

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

Environmental Site Sampling

- Anomaly avoidance will be practiced during all sampling activities as described in the **Appendix A of the Work Plan**.
- Surface Soil Sampling- Site UXO-11
  - Grab surface soil samples will be collected from depths of 0-2 inches.
  - The location of each sample will be pre-populated in a handheld GPS prior to the sampling event. The field team will make every effort to locate the coordinates; however, the sample location may be slightly adjusted to a field-suitable location (i.e. poison ivy free area, etc.). The actual coordinates of the sampling locations will then be logged into the GPS and will be based on the center of the sampling area.
- Subsurface Soil Sampling- UXO-11
  - Subsurface soil samples will be collected from the unsaturated zone immediately above the water table (estimated at 5 feet below ground surface) by hand augering.
  - The location of each sample will be pre-populated in a handheld GPS prior to the sampling event. The field team will make every effort to locate the coordinates; however, the sample location may be slightly adjusted to a field-suitable location (i.e. poison ivy free area, etc.). The actual coordinates of the sampling locations will then be logged into the GPS.
- Surface Water and Sediment Sampling- Site UXO-11
  - Field parameters (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 SOP protocols located in Worksheet #21. Surface water samples will always be collected first at each location to minimize increased turbidity and agitation caused by sediment collection. Sediment will be collected using a pre-washed 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 handheld GPS in the field. All coordinates will be recorded in the field logbook.

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

- Monitoring Well Installation- Site UXO-11 and UXO-17
  - Shallow groundwater monitoring wells will be constructed to allow collection of groundwater samples. Each well will be constructed of 2-inch Schedule 40 polyvinyl chloride (PVC). Wells will be constructed using 10 feet of 2-inch inside diameter, 0.010-inch machine slotted Schedule 40 PVC screen with a bottom cap. The wells will be installed by auger in accordance with the "Monitoring Well Installation SOP" located in Worksheet #21. The well screen will be installed to bracket the water table. Each well will be completed with a #2 filter pack from the bottom of the well to 2 feet above the top of the screen interval. A 2-foot hydrated bentonite seal will be installed above the filter pack and allowed to hydrate for 30 minutes prior to grouting with bentonite /Portland cement slurry to ground surface. Each well will be completed with a flush-mounted, traffic-rated well monument and locking well cap.
  - The monitoring wells will be developed by the drilling contractor. The primary purpose of well development is to reduce turbidity.
  - Static groundwater elevations will be measured in all monitoring wells using a water level indicator or oil/water interface probe, as appropriate. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot. The indicator will be decontaminated after use in each well.
- Groundwater Sampling- Site UXO-11 and UXO-17
  - Groundwater samples will be collected using a peristaltic or bladder pump following low-flow sampling protocol, and analyzed for parameters as detailed on Worksheet #20 and the "Groundwater Sampling SOP" located in Worksheet #21. All groundwater samples will be collected by placing the sample tubing or pump intake in the middle of the water column.
  - Water quality parameters (WQPs), including specific conductance, pH, turbidity, temperature, DO, and 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, DO within 10 percent, ORP within 10 mV and turbidity within 10 percent or as low as practicable for three consecutive readings. Depth to water, purge volume, WQPs, and total well depth measurements will be recorded in the field logbook.

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

- Post-detonation Soil Sampling- Sites UXO-11 and UXO-17 (as applicable)
  - Soil samples will be collected at locations where controlled detonations/BIP operations are conducted and at locations where MEC/MPPEH filler appears to have leaked into the adjacent soil. Composite surface soil samples will be collected using the TR-02-1 sampling approach in the resulting crater, and the incremental sampling method will be utilized to collect a sample from outside of the crater (as described in **Section 3.4 of the Work Plan**). In the instances where MEC/MPPEH is consolidated for controlled detonation and where it the MEC/MPPEH filler appears to have leaked to the adjacent soil, composite soil samples will be collected using the TR-02-01 sampling approach.
  - The coordinates of the sampling locations will be logged into the GPS.

Decontamination and Investigation-Derived Waste (IDW) Handling

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

Demobilization

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

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

Analyses and Testing Tasks

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

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

Quality Control Tasks

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

Secondary Data

- Secondary data (Worksheet #13) provided by CH2M HILL will be incorporated into subsequent reports, as needed.

Data Validation, Review, and Management Tasks

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

Documentation and Reporting

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

Assessment/Audit Tasks

- See Worksheets #31 and #32.

SAP Worksheet #15-1: Reference Limits and Evaluation Tables – UXO-11

Matrix: Surface Soil, Subsurface Soil, Sediment
Analytical Group: Metals
Concentration Level: Medium

Analyte	CAS No.	CLEAN MCB CamLej Background SS 2X Mean (mg/kg)	CLEAN MCB CamLej Background SB 2X Mean (mg/kg)	NCSSL (Jan. 2010) (mg/kg)	RSLs Industrial for soil (June 2011) (mg/kg)	RSLs Residential for soil (June 2011) (mg/kg)	Project Quantitation Limit Goal (mg/kg)	Laboratory-specific (mg/kg)			LCS, MS, and MSD %R Limits[3]	
								LOQ	LOD	DL	LCL	UCL
Chromium	7440-47-3	6.05	14.5	3.8	5.6	0.29	0.145	0.5	0.25	0.05	80	120
Chromium VI (Hexavalent)	18540-29-9	NC	NC	3.8	5.6	0.29	0.145	1.0	0.40	0.16	70	130

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).

[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits.

SAP Worksheet #15-2: Reference Limits and Evaluation Tables – UXO-11

Matrix: Surface Soil, Subsurface Soil, Sediment
Analytical Group: Explosives, including Perchlorate
Concentration Level: Medium

Analyte	CAS No.	CLEAN RSLs Industrial Soil Adjusted, (June 2011) (ug/kg)	CLEAN RSLs Residential Soil Adjusted, (June 2011) (ug/kg)	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific (ug/kg)			LCS, MS, and MSD %R Limits[3]	
					LOQ	LOD	DL	LCL	UCL
1,3,5-Trinitrobenzene	99-35-4	2700000	220000	110000	500	200	100	**75**	**125**
1,3-Dinitrobenzene	99-65-0	6200	610	305	500	200	100	**80**	**125**
2,4,6-Trinitrotoluene	118-96-7	42000	3600	1800	500	200	100	**55**	**140**
2,4-Dinitrotoluene	121-14-2	5500	1600	800	500	200	100	**80**	**125**
2,6-Dinitrotoluene	606-20-2	62000	6100	3050	500	200	100	**80**	**120**
2-Amino-4,6-dinitrotoluene	35572-78-2	200000	15000	7500	500	300	150	**80**	**125**
2-Nitrotoluene	88-72-2	13000	2900	1450	2000	1460	730	**80**	**125**
3-Nitrotoluene	99-08-1	6200	610	305	500	300	150	**75**	**120**
4-Amino-2,6-dinitrotoluene	19406-51-0	190000	15000	7500	500	200	100	**80**	**125**
4-Nitrotoluene	99-99-0	110000	24000	12000	500	300	150	**75**	**125**
HMX	2691-41-0	4900000	380000	190000	500	300	100	**70**	**125**
Nitrobenzene	98-95-3	24000	4800	2400	500	200	100	**75**	**125**
Nitroglycerin	55-63-0	6200	610	305	1000	500	250	**60**	**120**
Pentaerythritol tetranitrate (PETN)	78-11-5	120000	12000	6000	1000	500	250	**60**	**120**
RDX	121-82-4	24000	5600	2800	500	200	100	**70**	**135**
Tetryl	479-45-8	250000	24000	12000	500	200	100	**10**	**150**
Perchlorate	14797-73-0	72000	5500	2750	2	1	0.5	80	120

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs. There are no background values for explosives at MCB CamLej. There are no NCSSLs for explosives.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).

[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.1 limits do not exist.

SAP Worksheet #15-3: Reference Limits and Evaluation Tables – UXO-11

Matrix: Groundwater
Analytical Group: Total and Dissolved Metals
Concentration Level: Medium

Analytes	CAS No.	MCB CamLej Background GW 2X Mean (ug/L)	NC2L (Jan. 2010) (ug/L)	CLEAN RSLs Tapwater Adjusted (June 2011) (ug/L)	MCL (ug/L)	Project Quantitation Limit Goal (ug/L)	Laboratory-specific (ug/L)			LCS, MS, and MSD %R Limits[3]	
							LOQ	LOD	DL	LCL	UCL
Chromium	7440-47-3	3.13	10	0.043	100	**0.0215**	6.0	3.0	0.450	80	120
Chromium (Hexavalent)	18540-29-9	NC	10	0.043	100	**0.0215**	30	15	5.4	80	120

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs. There are no NC2B criteria for these analytes.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).
[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.1 limits do not exist.

SAP Worksheet #15-4: Reference Limits and Evaluation Tables – UXO-11

Matrix: Surface Water
Analytical Group: Total and Dissolved Metals
Concentration Level: Medium

Analytes	CAS No.	NRWQC (Jan. 2010) (ug/L)	CLEAN RSLs Tapwater Adjusted (June 2011) (ug/L)	Project Quantitation Limit Goal (ug/L)	Laboratory-specific (ug/L)			LCS, MS, and MSD %R Limits[3]	
					LOQ	LOD	DL	LCL	UCL
Chromium	7440-47-3	100	0.043	0.0215	6.0	3.0	0.450	80	120
Chromium (Hexavalent)	18540-29-9	NC	0.043	0.0215	30	15	5.4	80	120

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs. There are no NC2B criteria for these analytes.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).

[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits.

SAP Worksheet #15-5: Reference Limits and Evaluation Tables – UXO-11

Matrix: Surface Water, Groundwater
Analytical Group: Explosives, including Perchlorate
Concentration Level: Medium

Analyte	CAS No.	NRWQC (Jan. 2010) (ug/L)	CLEAN RSLs Tapwater Adjusted (June 2011) (ug/L)	Project Quantitation Limit Goal (ug/L)	Laboratory-specific (ug/L)			LCS, MS, and MSD %R Limits[3]	
					LOQ	LOD	DL	LCL	UCL
1,3,5-Trinitrobenzene	99-35-4	NC	110	55	0.325	0.208	0.104	69	114
1,3-Dinitrobenzene	99-65-0	NC	0.37	0.185	0.325	0.208	0.104	77	109
2,4,6-Trinitrotoluene	118-96-7	NC	1.8	0.9	0.325	0.208	0.104	70	126
2,4-Dinitrotoluene	121-14-2	0.11	NA	0.055	0.325	0.208	0.104	76	117
2,6-Dinitrotoluene	606-20-2	NC	3.7	1.85	0.325	0.156	0.078	78	109
2-Amino-4,6-dinitrotoluene	35572-78-2	NC	7.3	3.65	0.325	0.208	0.104	70	125
2-Nitrotoluene	88-72-2	NC	0.31	0.155	0.325	0.208	0.104	59	113
3-Nitrotoluene	99-08-1	NC	0.37	0.185	0.325	0.208	0.104	58	114
4-Amino-2,6-dinitrotoluene	19406-51-0	NC	7.3	3.65	0.325	0.208	0.104	68	126
4-Nitrotoluene	99-99-0	NC	4.2	2.1	0.65	0.208	0.104	60	120
HMX	2691-41-0	NC	180	90	0.325	0.208	0.104	55	120
Nitrobenzene	98-95-3	17	NA	8.5	0.325	0.208	0.104	63	110
Nitroglycerin	55-63-0	NC	0.37	0.185	1.3	0.65	0.325	45	134
Pentaerythritol tetranitrate (PETN)	78-11-5	NC	7.3	3.65	1.3	0.26	0.13	56	139
RDX	121-82-4	NC	0.61	0.305	0.325	0.208	0.104	65	132
Tetryl	479-45-8	NC	15	7.5	0.65	0.26	0.13	59	123
Perchlorate	14797-73-0	NC	2.6	1.3	0.2	0.1	0.05	80	120

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs. There are no NC2B Standards for explosives.
[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).
[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.1 limits do not exist.

SAP Worksheet #15-6: Reference Limits and Evaluation Tables – UXO-17

Matrix: Groundwater
Analytical Group: VOCs
Concentration Level: Medium

Analyte	CAS No.	NC2L (Jan. 2010) (ug/l)	CLEAN RSLs Tapwater Adjusted (Jan. 2010) (ug/l)	MCL (ug/L)	Project Quantitation Limit Goal (ug/L)	Laboratory-specific (ug/L)			LCS, MS, and MSD %R Limits[3]	
						LOQ	LOD	DL	LCL	UCL
1,1,1-Trichloroethane	71-55-6	200	910	200	100	1.0	1.0	0.59	65	130
1,1,2,2-Tetrachloroethane	79-34-5	0.2	0.067	NC	0.0335	1.0	1.0	0.54	65	130
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	200000	5900	NC	2950	1.0	1.0	0.73	**47**	**173**
1,1,2-Trichloroethane	79-00-5	NC	0.042	5	0.021	1.0	1.0	0.63	75	125
1,1-Dichloroethane	75-34-3	6	2.4	NC	1.2	1.0	1.0	0.57	70	135
1,1-Dichloroethene	75-35-4	7	34	7	3.5	1.0	1.0	0.94	70	130
1,2,4-Trichlorobenzene	120-82-1	70	0.41	70	0.205	1.0	1.0	0.70	65	135
1,2-Dibromo-3-chloropropane	96-12-8	0.04	0.00032	0.2	0.00016	1.0	1.0	0.96	50	130
1,2-Dibromoethane	106-93-4	0.02	0.0065	0.05	0.00325	1.0	1.0	0.78	80	120
1,2-Dichlorobenzene	95-50-1	20	37	600	10	1.0	1.0	0.57	70	120
1,2-Dichloroethane	107-06-2	0.4	0.15	5	0.075	1.0	1.0	0.50	70	130
1,2-Dichloropropane	78-87-5	0.6	0.39	5	0.195	1.0	1.0	0.80	75	125
1,3-Dichlorobenzene	541-73-1	200		NC	100	1.0	1.0	0.53	75	125
1,4-Dichlorobenzene	106-46-7	6	0.43	75	0.215	1.0	1.0	0.46	75	125
2-Butanone	78-93-3	4000	710	NC	355	5.0	2.5	4.5	30	150
2-Hexanone	591-78-6	NC	4.7	NC	2.35	5.0	2.5	1.4	55	130
4-Methyl-2-pentanone	108-10-1	NC	200	NC	100	5.0	2.5	2.8	60	135
Acetone	67-64-1	6000	2200	NC	1100	5.0	2.5	1.8	40	140
Benzene	71-43-2	1	0.41	5	0.205	1.0	1.0	0.58	80	120
Bromodichloromethane	75-27-4	0.6	0.12	80	0.06	1.0	1.0	0.49	75	120
Bromoform	75-25-2	4	8.5	80	2	1.0	1.0	0.75	70	130
Bromomethane	74-83-9	NC	0.87	NC	0.435	1.0	1.0	0.95	30	145
Carbon disulfide	75-15-0	700	100	NC	50	5.0	5.0	1.9	35	160
Carbon tetrachloride	56-23-5	0.3	0.44	5	0.15	1.0	1.0	0.65	65	140
Chlorobenzene	108-90-7	50	9.1	100	4.55	1.0	1.0	0.51	80	120
Chloroethane	75-00-3	3000	2100	NC	1050	1.0	1.0	0.98	60	135
Chloroform	67-66-3	70	0.19	80	0.095	1.0	1.0	0.54	65	135
Chloromethane	74-87-3	3	19	NC	1.5	1.0	1.0	0.82	40	125
cis-1,2-Dichloroethene	156-59-2	70	7.3	70	3.65	1.0	1.0	0.49	70	125
cis-1,3-Dichloropropene	10061-01-5	0.4	0.43	NC	0.2	1.0	1.0	0.59	70	130
Cyclohexane	110-82-7	NC	1300	NC	650	2.0	1.0	0.93	**70**	**130**
Dibromochloromethane	124-48-1	0.4	0.15	80	0.075	1.0	1.0	0.44	60	135
Dichlorodifluoromethane (Freon-12)	75-71-8	1000	20	NC	10	1.0	1.0	0.74	30	155

SAP Worksheet #15-6: Reference Limits and Evaluation Tables – UXO-17 (continued)

Matrix: Groundwater
Analytical Group: VOCs
Concentration Level: Medium

Analyte	CAS No.	NC2L (Jan. 2010) (ug/l)	CLEAN RSLs Tapwater Adjusted (Jan. 2010) (ug/l)	MCL (ug/L)	Project Quantitation Limit Goal (ug/L)	Laboratory-specific (ug/L)			LCS, MS, and MSD %R Limits[3]	
Ethylbenzene	100-41-4	600	1.5	700	0.75	1.0	1.0	0.69	75	125
Isopropylbenzene	98-82-8	70	68	NC	34	1.0	1.0	0.67	75	125
Methyl Acetate	79-20-9	NC	3700	NC	1850	2.0	1.0	0.95	**70**	**130**
Methyl-tert-butyl ether (MTBE)	1634-04-4	20	12	NC	6	1.0	1.0	0.60	65	125
Methylcyclohexane	108-87-2	NC		NC	0	2.0	1.0	0.59	**70**	**130**
Methylene chloride	75-09-2	5	4.8	5	2.4	5.0	5.0	0.69	55	140
Styrene	100-42-5	70	160	100	35	1.0	1.0	0.49	65	135
Tetrachloroethene	127-18-4	0.7	0.11	5	0.055	1.0	1.0	0.76	45	150
Toluene	108-88-3	600	230	1000	115	1.0	1.0	0.58	75	120
trans-1,2-Dichloroethene	156-60-5	100	11	100	5.5	1.0	1.0	0.72	60	140
trans-1,3-Dichloropropene	10061-02-6	0.4	0.43	NC	0.2	1.0	1.0	0.64	55	140
Trichloroethene	79-01-6	3	2	5	1	1.0	1.0	0.55	70	125
Trichlorofluoromethane(Freon-11)	75-69-4	2000	130	NC	65	1.0	1.0	0.68	60	145
Vinyl chloride	75-01-4	0.03	0.016	2	0.008	1.0	1.0	0.71	50	145
Xylene, total	1330-20-7	500	20	10000	10	2.0	2.0	1.3	75	130

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs. There are no base backgound values for VOCs.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).

[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.1 limits do not exist.

Shading represents cases where the PAL or project QL goal is lower than the laboratory LOD.

SAP Worksheet #15-7: Reference Limits and Evaluation Tables – UXO-17

Matrix: Groundwater
Analytical Group: SVOCs
Concentration Level: Medium

Analyte	CAS No.	NC2L (Jan. 2010) (ug/l)	CLEAN RSLs Tapwater Adjusted (Jan. 2010) (ug/l)	MCL (ug/L)	Project Quantitation Limit Goal (ug/L)	Laboratory-specific (ug/L)			LCS, MS, and MSD %R Limits[3]	
						LOQ	LOD	DL	LCL	UCL
1,1-Biphenyl	92-52-4	400	0.083	NC	0.0415	10	5.0	2.50	**46**	**83**
2,2'-Oxybis(1-chloropropane)	108-60-1	NC	0.32	NC	0.16	10	6.0	2.40	25	130
2,4,5-Trichlorophenol	95-95-4	NC	370	NC	185	10	3.0	1.50	50	110
2,4,6-Trichlorophenol	88-06-2	NC	3.7	NC	1.85	10	6.0	3.30	50	115
2,4-Dichlorophenol	120-83-2	NC	11	NC	5.5	10	6.0	4.00	50	105
2,4-Dimethylphenol	105-67-9	100	73	NC	36.5	10	6.0	3.00	30	110
2,4-Dinitrophenol	51-28-5	NC	7.3	NC	3.65	10	6.0	3.30	15	140
2,4-Dinitrotoluene	121-14-2	NC	0.22	NC	0.11	10	3.0	2.10	50	120
2,6-Dinitrotoluene	606-20-2	NC	3.7	NC	1.85	10	3.0	2.40	50	115
2-Chloronaphthalene	91-58-7	NC	290	NC	145	10	3.0	1.90	50	105
2-Chlorophenol	95-57-8	NC	18	NC	9	10	6.0	3.60	35	105
2-Methylnaphthalene	91-57-6	30	15	NC	7.5	10	3.0	2.1	45	105
2-Methylphenol	95-48-7	NC	180	NC	90	10	6.0	1.60	40	110
2-Nitroaniline	88-74-4	NC	37	NC	18.5	10	6.0	2.50	50	115
2-Nitrophenol	88-75-5	NC	18	NC	9	10	6.0	4.20	40	115
3,3'-Dichlorobenzidine	91-94-1	NC	0.15	NC	0.075	10	3.0	2.30	20	110
3-Nitroaniline	99-09-2	NC	NC	NC	Lab LOD	10	3.0	2.10	25	125
4,6-Dinitro-2-methylphenol	534-52-1	NC	0.29	NC	0.145	10	6.0	4.30	40	130
4-Bromophenyl-phenylether	101-55-3	NC	NC	NC	Lab LOD	10	3.0	1.40	50	115
4-Chloro-3-methylphenol	59-50-7	NC	370	NC	185	10	6.0	3.10	45	110
4-Chloroaniline	106-47-8	NC	0.34	NC	0.17	10	6.0	2.40	15	110
4-Chlorophenyl-phenylether	7005-72-3	NC	18	NC	9	10	3.0	1.90	50	110
3&4-Methylphenol	106-44-5	40	18	NC	9	10	6.0	3.50	30	110
4-Nitroaniline	100-01-6	NC	3.4	NC	1.7	10	3.0	2.20	35	120
4-Nitrophenol	100-02-7	NC	0.12	NC	0.06	10	3.0	1.80	0	125
Acenaphthene	83-32-9	80	220	NC	40	10	3.0	2.1	45	110
Acenaphthylene	208-96-8	200	220	NC	100	10	3.0	2.3	50	105
Acetophenone	98-86-2	NC	370	NC	185	10	6.0	4.80	**70**	**130**
Anthracene	120-12-7	2000	1100	NC	550	10	3.0	1.8	55	110
Atrazine	1912-24-9	NC	0.29	3	0.145	10	5.0	2.60	**70**	**130**
Benzaldehyde	100-52-7	NC	370	NC	185	10	5.0	2.60	**43**	**87**
Benzo(a)anthracene	56-55-3	0.05	0.029	NC	0.0145	10	3.0	2.3	55	110
Benzo(a)pyrene	50-32-8	0.005	0.0029	0.2	0.00145	10	3.0	2.2	55	110
Benzo(b)fluoranthene	205-99-2	0.05	0.029	NC	0.0145	10	3.0	2.0	45	120
Benzo(g,h,i)perylene	191-24-2	200	110	NC	55	10	3.0	2.2	40	125

SAP Worksheet #15-7: Reference Limits and Evaluation Tables – UXO-17 (continued)

Matrix: Groundwater
Analytical Group: SVOCs
Concentration Level: Medium

Analyte	CAS No.	NC2L (Jan. 2010) (ug/l)	CLEAN RSLs Tapwater Adjusted (Jan. 2010) (ug/l)	MCL (ug/L)	Project Quantitation Limit Goal (ug/L)	Laboratory-specific (ug/L)			LCS, MS, and MSD %R Limits[3]	
Benzo(k)fluoranthene	207-08-9	0.5	0.29	NC	0.145	10	3.0	2.2	45	125
bis(2-Chloroethoxy)methane	111-91-1	NC	11	NC	5.5	10	6.0	2.40	45	105
bis(2-Chloroethyl)ether	111-44-4	0.03	0.012	NC	0.006	10	6.0	2.40	35	110
bis(2-Ethylhexyl)phthalate	117-81-7	3	4.8	6	1.5	10	3.0	2.70	40	125
Butylbenzylphthalate	85-68-7	1000	35	NC	17.5	10	3.0	3.40	45	115
Caprolactam	105-60-2	4000	1800	NC	900	10	4.0	0.920	**13**	**24**
Carbazole	86-74-8	NC	NC	NC	Lab LOD	10	3.0	1.90	50	115
Chrysene	218-01-9	5	2.9	NC	1.45	10	3.0	2.5	55	110
Dibenz(a,h)anthracene	53-70-3	0.005	0.0029	NC	0.00145	10	3.0	1.9	40	125
Dibenzofuran	132-64-9	NC	3.7	NC	1.85	10	3.0	2.30	55	105
Diethylphthalate	84-66-2	6000	2900	NC	1450	10	3.0	2.10	40	120
Dimethyl phthalate	131-11-3	NC	NC	NC	Lab LOD	10	3.0	2.00	25	125
Di-n-butylphthalate	84-74-2	700	370	NC	185	10	3.0	2.50	55	115
Di-n-octylphthalate	117-84-0	100	4.8	NC	2.4	10	3.0	2.30	35	135
Fluoranthene	206-44-0	300	150	NC	75	10	3.0	2.5	55	115
Fluorene	86-73-7	300	150	NC	75	10	3.0	2.1	50	110
Hexachlorobenzene	118-74-1	0.02	0.042	1	0.01	10	3.0	1.20	50	110
Hexachlorobutadiene	87-68-3	0.4	0.86	NC	0.2	10	3.0	1.40	25	105
Hexachlorocyclopentadiene	77-47-4	NC	22	50	11	10	3.0	1.10	**13**	**120**
Hexachloroethane	67-72-1	NC	3.7	NC	1.85	10	6.0	1.60	30	100
Indeno(1,2,3-cd)pyrene	193-39-5	0.05	0.029	NC	0.0145	10	3.0	2.2	45	125
Isophorone	78-59-1	40	71	NC	20	10	6.0	2.70	50	110
Naphthalene	91-20-3	6	0.14	NC	0.07	10	6.0	2.1	40	100
Nitrobenzene	98-95-3	NC	0.12	NC	0.06	10	6.0	2.60	45	110
n-Nitroso-di-n-propylamine	621-64-7	NC	0.0096	NC	0.0048	10	6.0	2.60	35	130
n-Nitrosodiphenylamine	86-30-6	NC	14	NC	7	10	6.0	3.80	50	110
Pentachlorophenol	87-86-5	0.3	0.17	1	0.085	10	3.0	3.50	40	115
Phenanthrene	85-01-8	200	1100	NC	100	10	3.0	1.5	50	115
Phenol	108-95-2	30	1100	NC	15	10	6.0	1.70	**40**	115
Pyrene	129-00-0	200	110	NC	55	10	3.0	2.6	50	130

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs. There are no base backgound values for SVOCs.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).

[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.1 limits do not exist.

Shading represents cases where the PAL or project QL goal is lower than the laboratory LOD.

SAP Worksheet #15-8: Reference Limits and Evaluation Tables – UXO-11 and 17 Post-Detonation Sampling

Matrix: Surface Soil Composite, Surface Soil Incremental
Analytical Group: Metals
Concentration Level: Medium

Analyte	CAS No.	CLEAN MCB CamLej Background SS 2X Mean (mg/kg)	CLEAN MCB CamLej Background SB 2X Mean (mg/kg)	NCSSL (Jan. 2010) (mg/kg)	RSLs Industrial for soil (June 2011) (mg/kg)	RSLs Residential for soil (June 2011) (mg/kg)	Project Quantitation Limit Goal (mg/kg)	Laboratory-specific (mg/kg)			LCS, MS, and MSD %R Limits[3]	
								LOQ	LOD	DL	LCL	UCL
Aluminum	7429-90-5	5487	10369	NC	99000	7700	2743.5	10	5	2.7	80	120
Antimony	7440-36-0	0.447	0.36	NC	41	3.1	0.18	2	1	0.49	80	120
Arsenic	7440-38-2	0.626	2.12	5.8	1.6	0.39	0.195	2	1	0.39	80	120
Barium	7440-39-3	14.5	16.6	580	19000	1500	7.25	5	0.25	0.019	80	120
Beryllium	7440-41-7	0.103	0.165	NC	200	16	0.0515	0.05	0.025	0.0071	80	120
Cadmium	7440-43-9	0.033	0.023	3	80	7	0.0115	0.2	0.1	0.014	80	120
Calcium	7440-70-2	6360	441	NC	NC	NC	220.5	25	12.5	0.67	80	120
Chromium	7440-47-3	6.05	14.5	3.8	5.6	0.29	0.145	0.5	0.25	0.05	80	120
Cobalt	7440-48-4	0.294	0.822	NC	30	2.3	0.147	0.5	0.25	0.03	80	120
Copper	7440-50-8	4.83	2.56	700	4100	310	1.28	0.5	0.25	0.16	80	120
Iron	7439-89-6	3245	5439	150	72000	5500	75	10	5	1.4	80	120
Lead	7439-92-1	12.3	8.49	270	800	400	4.245	1	0.5	0.24	80	120
Magnesium	7439-95-4	238	363	NC	NC	NC	119	25	12.5	1.4	80	120
Manganese	7439-96-5	13.7	9.25	65	2300	180	4.625	1	0.5	0.045	80	120
Mercury	7439-97-6	0.081	0.071	1	31	2.3	0.0355	0.0019	0.0081	0.0162	80	120
Nickel	7440-02-0	1.21	2.27	130	2000	150	0.605	0.5	0.25	0.08	80	120
Potassium	7440-09-7	116	361	NC	NC	NC	58	25	12.5	7.9	80	120
Selenium	7782-49-2	0.563	0.505	2.1	510	39	0.2525	2	1	0.48	80	120
Silver	7440-22-4	0.14	0.129	3.4	510	39	0.0645	0.5	0.25	0.063	80	120
Sodium	7440-23-5	80.9	68.3	NC	NC	NC	34.15	25	12.5	9	80	120
Thallium	7440-28-0	0.36	0.38	NC	1	0.078	0.039	1	0.5	0.32	80	120
Vanadium	7440-62-2	8.9	17.2	NC	520	39	4.45	0.5	0.25	0.072	80	120
Zinc	7440-66-6	10.8	6.59	1200	31000	2300	3.295	0.5	0.25	0.19	80	120

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).

[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.1 limits do not exist.

Shading represents cases where the PAL or project QL goal is lower than the laboratory LOD.

SAP Worksheet #15-9: Reference Limits and Evaluation Tables – UXO-11 and 17 Post-Detonation Sampling

Matrix: Surface Soil Composite, Surface Soil Incremental
Analytical Group: Explosives, including Perchlorate
Concentration Level: Medium

Analyte	CAS No.	CLEAN RSLs Industrial Soil Adjusted, (June 2011) (ug/kg)	CLEAN RSLs Residential Soil Adjusted, (June 2011) (ug/kg)	Project Quantitation Limit Goal (ug/kg)	Laboratory-specific (ug/kg)			LCS, MS, and MSD %R Limits[3]	
					LOQ	LOD	DL	LCL	UCL
1,3,5-Trinitrobenzene	99-35-4	2700000	220000	110000	500	200	100	75	125
1,3-Dinitrobenzene	99-65-0	6200	610	305	500	200	100	80	125
2,4,6-Trinitrotoluene	118-96-7	42000	3600	1800	500	200	100	55	140
2,4-Dinitrotoluene	121-14-2	5500	1600	800	500	200	100	80	125
2,6-Dinitrotoluene	606-20-2	62000	6100	3050	500	200	100	80	120
2-Amino-4,6-dinitrotoluene	35572-78-2	200000	15000	7500	500	300	150	80	125
2-Nitrotoluene	88-72-2	13000	2900	1450	2000	1460	730	80	125
3-Nitrotoluene	99-08-1	6200	610	305	500	300	150	75	120
4-Amino-2,6-dinitrotoluene	19406-51-0	190000	15000	7500	500	200	100	80	125
4-Nitrotoluene	99-99-0	110000	24000	12000	500	300	150	75	125
HMX	2691-41-0	4900000	380000	190000	500	300	100	70	125
Nitrobenzene	98-95-3	24000	4800	2400	500	200	100	75	125
Nitroglycerin	55-63-0	6200	610	305	1000	500	250	60	120
Pentaerythritol tetranitrate (PETN)	78-11-5	120000	12000	6000	1000	500	250	60	120
RDX	121-82-4	24000	5600	2800	500	200	100	70	135
Tetryl	479-45-8	250000	24000	12000	500	200	100	10	150
Perchlorate	14797-73-0	72000	5500	2750	2	1	0.5	80	120

[1] PALs were developed to be protective of human health and the environment. Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs.
There are no background values for explosives at MCB CamLej. There are no NCSSLs for explosives.

[2] Project QL Goals are equal to half of the minimum of the applicable criteria (PALs).

[3] DoD QSM v.4.1 is the basis for LCS and MS/MSD limits. Bolded values represent in-house limits when DoD QSM v.4.1 limits do not exist.

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SAP Worksheet #16: Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY) Anticipated Date(s) of Initiation	Dates (MM/DD/YY) Anticipated Date of Completion	Deliverable	Deliverable Due Date
Work Plan preparation	CH2M HILL	5/19/11	7/5/11	Draft Work Plan Draft UFP SAP	7/5/11
UFP-SAP reviewed by Navy	Navy	7/7/11	7/8/11	Comments	
UFP-SAP– address Navy comments	CH2M HILL	7/11/11	7/11/11	Draft Work Plan Draft UFP SAP	7/11/11
UFP-SAP Review and Approval by Regulatory Agencies	NC DENR, EPA Region IV	7/12/11	7/15/11	Comments	
Comment resolution	Navy, CH2M HILL	7/18//11	7/19/11	Final Work Plan Final UFP SAP	7/19/11
Final acceptance	Navy, NC DENR, EPA Region IV	7/20/11	7/25/11	Final Work Plan Final UFP SAP	7/25/11
Subcontracting	CH2M HILL	5/19/11	7/11/11	Subcontractor Contracts	
Site UXO-11 Intrusive Anomaly Investigation	Subcontractor w/ CH2M HILL	8/2/11	8/2/11	Anomaly Investigation	
Site UXO-11 Field Sampling Activities	CH2M HILL	7/11/11	7/22/11	Environ. Samples	
Site UXO-17 Vegetation Clearance	Subcontractors w/ CH2M HILL	713/11	7/18/11	Vegetation Clearance	
Site UXO-17 Intrusive Anomaly Investigation	Subcontractor w/ CH2M HILL	7/25/11	7/29/11	Anomaly Investigation	
Site UXO-17 Field Sampling Activities	CH2M HILL, Subcontractor for drilling/well installation	7/14/11	7/26/11	Environ. Samples	
Laboratory analyses and data validation	CH2M HILL	7/25/11	8/16/11	Analytical and DV Reports	8/16/11
Site UXO-11 Data management and report preparation	CH2M HILL	8/16/11	9/12/11	Site UXO-11 Draft Expanded SI Report	9/12/11
Site UXO-17 Data management and report preparation	CH2M HILL	8/18/11	9/14/11	Site UXO-17 Draft Expanded SI Report	9/14/11

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SAP Worksheet #17: Sampling Design and Rationale

General Approach: The general approach for sampling was developed to meet Navy, USEPA, and NCDENR requirements for the expanded site inspection. One of the objectives of this investigation is to further characterize potential human health and ecological risks at Site UXO 11 and UXO-17.

At Site UXO-11, the explosives residue nitroglycerin exceeded screening criteria in surface soil and nitrobenzene exceeded screening criteria in groundwater. Chromium was detected above screening values in all media. Speciation of chromium would indicate whether chromium was present onsite as hexavalent chromium, the most toxic form. Grab surface soil, subsurface soil, sediment, surface, water, and groundwater samples will be collected and analyzed for explosives residues (including nitroglycerin and PETN), perchlorate, chromium, and hexavalent chromium. Groundwater samples will be additionally analyzed for dissolved chromium and dissolved hexavalent chromium.

At Site UXO-17, previous investigations were limited to MCs. In April 2011, a buried 55-gallon drum was found within the 4-acre portion of the site that was leaking an unknown substance. A sample collected from the drum indicated it contained VOCs, SVOCs, and metals. Impacted soil was removed. To evaluate impact to groundwater, three new monitoring wells will be installed and eight groundwater samples will be collected and analyzed for VOCs and SVOCs.

The site investigation will draw upon historical information and the results of the previous and ongoing investigations to guide the selection of areas for sample collection. The sample locations at Site UXO-17 are based upon the discovery of a leaking, buried 55-gallon drum in April 2011.

Sample Matrices: Sample matrices at Site UXO-11 will include surface soil, subsurface soil, sediment, surface water, and groundwater. The sample matrix at Site UXO-17 includes only groundwater.

Analytical Groups: The target analytical groups for Site UXO-11 will be explosives residues (including nitroglycerin and PETN), perchlorate, chromium, and hexavalent chromium.(for surface and subsurface soil and sediment); explosives residues (including nitroglycerin and PETN), perchlorate, total chromium, and total hexavalent chromium (for surface water), and explosives residues (including nitroglycerin and PETN), perchlorate, total chromium, dissolved chromium, total hexavalent chromium, and dissolved hexavalent chromium (for groundwater).

The target analytical groups for Site UXO-17 will be VOCs and SVOCs. The rationale for the selection of the target analytes was based on the analytical results from characterization sampling of the buried drum

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

Site Sample Numbers and Locations: The sampling approach, the rationale for the matrices to be sampled, the number of samples per matrix, the analytical groups, and the relevant concentration action levels are discussed in Worksheets #10-1 (Site UXO-11), #10-2 (Site UXO-17), #11, #14 and #15. Sample location figures are provided in Worksheets #10-1 and #10-2. Exact sampling locations will be determined in the field during the site reconnaissance conducted by CH2M HILL staff, and may be re-located to avoid site obstructions, if present. Site sampling locations were agreed upon by the project team.

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

SAP Worksheet #18-1: Location-Specific Sampling Methods/SOP Requirements Table - UXO-11

Sample Location	Screening Interval / QA/QC type	Sample ID	Explosive Residues, including PETN and Nitroglycerin	Perchlorate	TAL Metals	Total Hexavalent Chromium	Dissolved TAL Metals	Dissolved Hexavalent Chromium
Groundwater								
MR11-MW01		MR11-GW01-11C	X	X	X	X	X	X
MR11-MW02		MR11-GW02-11C	X	X	X	X	X	X
MR11-MW03		MR11-GW03-11C	X	X	X	X	X	X
MR11-MW04		MR11-GW04-11C	X	X	X	X	X	X
MR11-MW05		MR11-GW05-11C	X	X	X	X	X	X
Groundwater QA/QC								
MR11-MW##	Duplicate	MR11-GW##D-11C	X	X	X	X	X	X
MR11-MW##	MS	MR11-GW##-11C-MS	X	X	X	X	X	X
MR11-MW##	MSD	MR11-GW##-11C-SD	X	X	X	X	X	X
Surface Soil								
MR11-IS05	0-2" bgs	MR11-SS05-11C	X	X	X	X		
MR11-IS06	0-2" bgs	MR11-SS06-11C	X	X	X	X		
MR11-IS07	0-2" bgs	MR11-SS07-11C	X	X	X	X		
MR11-IS08	0-2" bgs	MR11-SS08-11C	X	X	X	X		
MR11-IS09	0-2" bgs	MR11-SS09-11C	X	X	X	X		
MR11-IS10	0-2" bgs	MR11-SS10-11C	X	X	X	X		
MR11-IS11	0-2" bgs	MR11-SS11-11C	X	X	X	X		
MR11-IS12	0-2" bgs	MR11-SS12-11C	X	X	X	X		
MR11-IS13	0-2" bgs	MR11-SS13-11C	X	X	X	X		
MR11-IS14	0-2" bgs	MR11-SS14-11C	X	X	X	X		
MR11-IS15	0-2" bgs	MR11-SS15-11C	X	X	X	X		
MR11-IS16	0-2" bgs	MR11-SS16-11C	X	X	X	X		
MR11-IS17	0-2" bgs	MR11-SS17-11C	X	X	X	X		
MR11-IS18	0-2" bgs	MR11-SS18-11C	X	X	X	X		
MR11-IS19	0-2" bgs	MR11-SS19-11C	X	X	X	X		
MR11-IS20	0-2" bgs	MR11-SS20-11C	X	X	X	X		
MR11-IS21	0-2" bgs	MR11-SS21-11C	X	X	X	X		
MR11-IS22	0-2" bgs	MR11-SS22-11C	X	X	X	X		
MR11-IS23	0-2" bgs	MR11-SS23-11C	X	X	X	X		
MR11-IS24	0-2" bgs	MR11-SS24-11C	X	X	X	X		

SAP Worksheet #18-1: Location-Specific Sampling Methods/SOP Requirements Table - UXO-11 (continued)

Sample Location	Screening Interval / QA/QC type	Sample ID	Explosive Residues, including PETN and Nitroglycerin	Perchlorate	TAL Metals	Total Hexavalent Chromium	Dissolved TAL Metals	Dissolved Hexavalent Chromium
Surface Soil QA/QC								
MR11-IS##	Duplicate	MR11-SB##D-11C	X	X	X	X		
MR11-IS##	Duplicate	MR11-SB##D-11C	X	X	X	X		
MR11-IS##	MS	MR11-SB##-11C-MS	X	X	X	X		
MR11-IS##	MSD	MR11-SB##-11C-SD	X	X	X	X		
Subsurface Soil								
MR11-IS05	approx. 5' bgs	MR11-SB05-11C	X	X	X	X		
MR11-IS06	approx. 5' bgs	MR11-SB06-11C	X	X	X	X		
MR11-IS07	approx. 5' bgs	MR11-SB07-11C	X	X	X	X		
MR11-IS08	approx. 5' bgs	MR11-SB08-11C	X	X	X	X		
MR11-IS09	approx. 5' bgs	MR11-SB09-11C	X	X	X	X		
MR11-IS10	approx. 5' bgs	MR11-SB10-11C	X	X	X	X		
MR11-IS11	approx. 5' bgs	MR11-SB11-11C	X	X	X	X		
MR11-IS12	approx. 5' bgs	MR11-SB12-11C	X	X	X	X		
MR11-IS13	approx. 5' bgs	MR11-SB13-11C	X	X	X	X		
MR11-IS14	approx. 5' bgs	MR11-SB14-11C	X	X	X	X		
MR11-IS15	approx. 5' bgs	MR11-SB15-11C	X	X	X	X		
MR11-IS16	approx. 5' bgs	MR11-SB16-11C	X	X	X	X		
MR11-IS17	approx. 5' bgs	MR11-SB17-11C	X	X	X	X		
MR11-IS18	approx. 5' bgs	MR11-SB18-11C	X	X	X	X		
MR11-IS19	approx. 5' bgs	MR11-SB19-11C	X	X	X	X		
MR11-IS20	approx. 5' bgs	MR11-SB20-11C	X	X	X	X		
MR11-IS21	approx. 5' bgs	MR11-SB21-11C	X	X	X	X		
MR11-IS22	approx. 5' bgs	MR11-SB22-11C	X	X	X	X		
MR11-IS23	approx. 5' bgs	MR11-SB23-11C	X	X	X	X		
MR11-IS24	approx. 5' bgs	MR11-SB24-11C	X	X	X	X		
Subsurface Soil QA/QC								
MR11-IS##	Duplicate	MR11-SB##D-11C	X	X	X	X		
MR11-IS##	Duplicate	MR11-SB##D-11C	X	X	X	X		
MR11-IS##	MS	MR11-SB##-11C-MS	X	X	X	X		
MR11-IS##	MSD	MR11-SB##-11C-SD	X	X	X	X		
Surface Water								
MR11-SW/SD03		MR11-SW03-11C	X	X	X	X	X	X
MR11-SW/SD04		MR11-SW04-11C	X	X	X	X	X	X

SAP Worksheet #18-1: Location-Specific Sampling Methods/SOP Requirements Table - UXO-11 (continued)

Sample Location	Screening Interval / QA/QC type	Sample ID	Explosive Residues, including PETN and Nitroglycerin	Perchlorate	TAL Metals	Total Hexavalent Chromium	Dissolved TAL Metals	Dissolved Hexavalent Chromium
Surface Water QA/QC								
MR11-SW/SD##	Duplicate	MR11-SW##D-11C	X	X	X	X		
MR11-SW/SD##	MS	MR11-SW##-11C-MS	X	X	X	X		
MR11-SW/SD##	MSD	MR11-SW##-11C-SD	X	X	X	X		
Sediment								
MR11-SW/SD03		MR11-SD03-11C	X	X	X	X		
MR11-SW/SD04		MR11-SD04-11C	X	X	X	X		
Sediment QA/QC								
MR11-SW/SD##	Duplicate	*MR11-SD##D-11C*	X	X	X	X		
MR11-SW/SD##	MS	*MR11-SD##-11C-MS*	X	X	X	X		
MR11-SW/SD##	MSD	*MR11-SD##-11C-SD*	X	X	X	X		
Non-station located QA/QC								
N/A	Equipment Blank	MR11-EB##-MMDDYY-GW	X	X	X	X	X	X
N/A	Equipment Blank	MR11-EB##-MMDDYY-SO	X	X	X	X		
N/A	Equipment Blank	MR11-EB##-MMDDYY-SW	X	X	X	X	X	X
N/A	Equipment Blank	MR11-EB##-MMDDYY-SD	X	X	X	X		
N/A	Field Blank	MR11-FB##-MMDDYY	X	X	X	X		

The number of QA/QC samples collected is dependent on the total number of samples collected and therefore will be adjusted as the number of sampling locations is adjusted.

[1] QA/QC samples consisting of Duplicates and MS/MSD are identified with sample locations for nomenclature purposes only. The actual location of these samples may vary. QA/QC sample IDs include additional identifiers; D = Duplicate; MS = Matrix Spike; SD = Matrix Spike Duplicate.

[2] QA/QC will be collected at the rate specified on Worksheet #12. QA/QC sample IDs include additional identifiers; EB = Equipment Blank; FB = Field Blank.

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SAP Worksheet #18-2: Location-Specific Sampling Methods/SOP Requirements Table - UXO-17

Sample Location	Screening Interval / QA/QC type	Sample ID	VOCs	SVOCs
MR17-TW09	3-13 ft	MR17-MW09-11C	X	X
MR17-TW11	4-14 ft	MR17-MW11-11C	X	X
MR17-TW13	7-17 ft	MR17-MW13-11C	X	X
MR17-TW14	6-16 ft	MR17-MW14-11C	X	X
MR17-TW15	3-13 ft	MR17-MW15-11C	X	X
MR17-TW16		MR17-MW16-11C	X	X
MR17-TW17		MR17-MW17-11C	X	X
MR17-TW18		MR17-MW18-11C	X	X
MR17-TW##	Duplicate	MR17-GW##D-11C	X	X
MR17-TW##	MSD	MR17-MW##-11C-MS	X	X
MR17-TW##	MSD	MR17-MW##11C-SD	X	X
N/A	Equipment Blank	MR17-EB##-MMDDYY	X	X
N/A	Field Blank	MR17-FB##-MMDDYY	X	X

SAP Worksheet #18-3: Location-Specific Sampling Methods/SOP Requirements Table – Post Detonation Sampling UXO-11 and UXO-17

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling SOP Reference	Analytical Group: TAL Metals (SW-846 6010C & 7470A/7471B)	Analytical Group: Explosives (SW-846 8330B)	Analytical Group: Perchlorate (SW-846 6850)
Composite Surface Soil[3]								
UXO-11	SS	MR11-SS25	0-2" bgs	MR11-SS25-IC-11C	See Worksheet #21	X	X	X
UXO-11 QA/QC - Duplicate[2]	SS		0-2" bgs	*MR11-SS25D-IC-11C*		X	X	X
UXO-11	SS		0-2" bgs	MR11-SS25-OC-11C		X	X	X
UXO-11 QA/QC - Duplicate[2]	SS		0-2" bgs	*MR11-SS25D-OC-11C*		X	X	X
UXO-17	SS	MR17-SS26	0-2" bgs	MR17-SS26-IC-11C		X	X	X
UXO-17- MS/SD[2]	SS		*0-2" bgs*	*MR17-SS26-IC-11C-MS*		X	X	X
UXO-17- MS/SD[2]	SS		*0-2" bgs*	*MR17-SS26-IC-11C-MSD*		X	X	X
UXO-17	SS		0-2" bgs	MR17-SS26-OC-11C		X	X	X
UXO-17- MS/SD[2]	SS		*0-2" bgs*	*MR17-SS26-OC-11C-MS*		X	X	X
UXO-17- MS/SD[2]	SS		*0-2" bgs*	*MR17-SS26-OC-11C-MSD*		X	X	X
Non-Well Location QA/QC Samples								
QA/QC	*AQ*	*N/A*	*N/A*	*MR17-EB##-MMDDYY*	See Worksheet #21	X	X	X
QA/QC	*AQ*	*N/A*	*N/A*	*MR17-FB##-MMDDYY*		X	X	X

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

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

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

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

SAP Worksheet #19: Field Sampling Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time
UXO-11						
Surface Soil, Subsurface Soil, Sediment	Explosives	SW-846 8330 / GL-OA-E-068	4 oz. glass jar	20g	Cool to 0-6°C	14 days
	Perchlorate	SW-846 6850 / GL-OA-E-067		20g		
	Chromium	SW-846 6010C / MET-05	4 oz. glass jar	10g	Cool to 0-6°C	6 months; 28 days for mercury
	Hexavalent Chromium	SW-846 7196A / WETS-64		10g		28 days
Groundwater, Surface Water	Explosives	SW-846 8330 / GL-OA-E-068	1L Amber	750mL	Cool to 0-6°C	14 days
	Perchlorate	SW-846 6850 / GL-OA-E-067	250mL plastic	10mL	Cool to 0-6°C	28 days
	Total Chromium	SW-846 6010C / MET-05	250mL plastic	80mL	pH < 2 with HNO3 and cool to 0-6 °C	6 months; 28 days for mercury
	Total Hexavalent Chromium	SW-846 7196A / WETS-64	250mL plastic	25mL	Cool to 0-6°C	24 hours
	Dissolved Chromium	S SW-846 6010C / MET-05	250mL plastic	80mL	pH < 2 with HNO3 and cool to 0-6 °C	6 months; 28 days for mercury
	Dissolved Hexavalent Chromium	SW-846 7196A / WETS-64	250mL plastic	25mL	Cool to 0-6°C	24 hours

SAP Worksheet #19: Field Sampling Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time
UXO-17						
Groundwater	VOCs	SW-846 8260B / VGCMS-05	3, 40mL Vials, Glass	3 X 40mL (no headspace)	HCl to pH<2, Cool to 0-6°C	14 days
	SVOCs	SW-846 8270D, 8270D-SIM / SVGCMS-03	1, 1 Liter, Amber Glass	500mL	Cool to 0-6°C	7 days to extraction / 40 days to analysis
UXO-11 and UXO-17 Post-Detonation Sampling						
Surface Soil Composite	Explosives	SW-846 8330B / GL-OA-E-068	4oz. glass jar	20g	Cool to 0-6°C	14 days
	Perchlorate	SW-846 6850 / GL-OA-E-067		20g		28 days
	TAL Metals	SW-846 6010C and 7471B / MET-05 and MET-16	4oz. glass jar	2g	Cool to 0-6 °C	6 months; 28 days for mercury

SAP Worksheet #20: Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations[1]	No. of Field Duplicates	No. of MS/MSDs[2]	No. of Field Blanks[3]	No. of Equip. Blanks[3]	No. of Trip Blanks[3]	Total No. of Samples to Lab
UXO-11 Sampling								
Surface Soil	Explosives	20	2	1	1	4	-	29
	Perchlorate	20	2	1	1	4	-	29
	Chromium	20	2	1	1	4	-	29
	Hexavalent Chromium	20	2	1	1	4	-	29
Subsurface Soil	Explosives	20	2	1	-	4	-	28
	Perchlorate	20	2	1	-	4	-	28
	Chromium	20	2	1	-	4	-	28
	Hexavalent Chromium	20	2	1	-	4	-	28
Sediment	Explosives	2	1	1	-	1	-	6
	Perchlorate	2	1	1	-	1	-	6
	Chromium	2	1	1	-	1	-	6
	Hexavalent Chromium	2	1	1	-	1	-	6
Surface Water	Explosives	2	1	1	-	1	-	6
	Perchlorate	2	1	1	-	1	-	6
	Chromium	2	1	1	-	1	-	6
	Hexavalent Chromium	2	1	1	-	1	-	6
	Filtered Chromium	2	1	1	-	1	-	6
	Filtered Hexavalent Chromium	2	1	1	-	1	-	6
Groundwater	Explosives	5	1	1	-	2	-	10
	Perchlorate	5	1	1	-	2	-	10
	Chromium	5	1	1	-	2	-	10
	Hexavalent Chromium	5	1	1	-	2	-	10
	Filtered Chromium	5	1	1	-	2	-	10
	Filtered Hexavalent Chromium	5	1	1	-	2	-	10

SAP Worksheet #20: Field Quality Control Sample Summary Table (continued)

Matrix	Analytical Group	No. of Sampling Locations[1]	No. of Field Duplicates	No. of MS/MSDs[2]	No. of Field Blanks[3]	No. of Equip. Blanks[3]	No. of Trip Blanks[3]	Total No. of Samples to Lab
UXO-17 Sampling								
Groundwater	VOC	8	1	1	1	4	4	20
	SVOC	8	1	1	1	4	-	16
UXO-11 and UXO-17 Post-Detonation Sampling								
Surface Soil Composite	Explosives	2	1	1	1	1	-	7
	Perchlorate	2	1	1	1	1	-	7
	TAL Metals	2	1	1	1	1	-	7

[1] If samples will be collected at different depths at the same location, each discrete sampling depth is counted as a separate sampling location or station.

[2] Although the MS/MSD is not typically considered a field QC, it is included here because location determination is often established in the field.

[3] The number of field, equipment and trip blanks is based on a fundamental assumption of the number of sampling days each event will require. Refer to **Worksheet #12** for field QA/QC sampling frequencies.

SAP Worksheet #21: Project Sampling SOP References Table

Reference Number	Title, Revision Number and / or Date	Originating Organization	Equipment Type	Modified for Project Work?	Comments
SOP-001	Completing Log Books, rev. 5/2011	CH2M HILL	Log Book Indelible Pen	No	
SOP-002	Locating and Clearing Underground Utilities, rev. 5/2011		Electromagnetic Inductance		
SOP-004	Sediment Sampling, rev. 5/2011		Stainless Steel Spoon and Bowls		
SOP-005	Soil Boring and Abandonment, rev. 5/2011		Drill rig		
SOP-06	Installation of Shallow Monitoring Wells, 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		

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

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

1 Activities may include calibration, verification, testing, and maintenance.

2 See Worksheet #21.

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SAP Worksheet #23: Analytical SOP References Table

Lab SOP Number	Title, Revision Date and/or Number	Last Reviewed	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
LOGINS-03	RECEIVING SAMPLES (Rev. 10, Effective 1/23/2010)	4/20/2011	NA	NA	NA	ENCO - Orlando	N
ADMIN-14	WASTE DISPOSAL AND CHARACTERIZATION (Rev. 5, 12/1/2009)	1/4/2011	NA	NA	NA	ENCO - Orlando	N
EXMT-09	Acid Digestion of Soil and Waste Samples for Analysis by ICP and ICP-MS, Dec. 4, 2009 (Rev. 5, 12/04/09)	3/30/2011	NA	Soil Metals Prep	NA	ENCO - Jacksonville	N
EXMT-12	Acid Digestion of Aqueous Samples for Analysis by ICP and ICP-MS (Rev. 4, 11/30/2009)	11/30/2010	NA	Aqueous Metals Prep	NA	ENCO - Orlando	N
EXSV-16	Extraction of Soil/Solid Samples Using Sonication, (Rev. 6, 3/23/2010)	4/14/2011	NA	Soils SVOC Prep	NA	ENCO - Orlando	N
EXSV-27	Extraction of Samples Using Separatory Funnel Techniques (Rev. 4, 3/2/2010)	4/14/2011	NA	Aqueous SVOC Prep	NA	ENCO - Orlando	N
MET-03	Mercury in Waters by Digestion/CVAA (Rev. 4, 12/4/2009)	01/11/2011	Definitive	Water/Mercury	CVAA	ENCO - Jacksonville	N
MET-05	Metals Analysis using ICP-AES (Rev. 7, 10/30/2009)	5/17/2011	Definitive	Soil, Aqueous Metals	ICP/AES	ENCO - Jacksonville	N
MET-16	Mercury in Soils by Digestion/CVAA (Rev. 4, Effective Date 3/1/2010)	12/1/2010	Definitive	Soil/Mercury	CVAA	ENCO - Jacksonville	N
WETS-64	Hexavalent Chromium (Colorimetric), Revision No. 8 (1/23/2010)	04/21/2011	Definitive	Aqueous Hexavalent Chromium	UV-VIS	ENCO - Orlando	N

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

Lab SOP Number	Title, Revision Date and/or Number	Last Reviewed	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
SVGCMS-03	Analysis of Semivolatile Organic Compounds by GCMS (Rev. 16, Effective 11/29/2010)	NA	Definitive	Soil, Aqueous SVOC	GC/MS	ENCO - Orlando	N
VGCMS-05	Analysis of Volatile Organic Compounds by GCMS (Rev.16, Effective 11/5/2010)	NA	Definitive	Soil, Aqueous VOC	GC/MS	ENCO - Orlando	N
GL-LB-G-001	Laboratory Waste Management Plan, Revision No. 19 (Feb 2011)	--	NA	All	NA	GEL Laboratories	N
GL-OA-E-033	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), Revision No. 19 (Jan. 2011)	--	Definitive	Solid Explosives	HPLC/DAD	GEL Laboratories	N
GL-OA-E-067	Definitive Low Level Perchlorate Analysis Utilizing LC/MS/MS by EPA Method 6850 Modified, Revision No. 7 (Oct 2010)	--	Definitive	Solid Perchlorate	LC/MS/MS	GEL Laboratories	N
GL-OA-E-068	The Extraction and Analysis of Nitroaromatics, Nitramines, and Nitrate Esters by SW-846 8330B, Revision No. 3 (October 2010)	--	Definitive	Solid Explosives	NA (prep method)	GEL Laboratories	N
GL-SR-E-001	Sample Acceptance Policy, Sample Login and Storage, Revision No. 32 (March 2011)	--	NA	All	NA	GEL Laboratories	N

SAP Worksheet #24-1: Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC-MS (VOCs, SVOCs)	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Analyst	VGCMS-05 VGCMS-03
	Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for SPCCs: VOCs ≥0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; VOCs ≥0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. 2. RSD for RFs for CCCs: VOCs and SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte≤ 15%; Option 2: linear least squares regression R≥ 0.995; Option 3: non-linear regression coefficient of determination (COD) R2 ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.		
	Second source calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Retention time window position establishment for each analyte and surrogate.	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		
	Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.		
	Continuing calibration verification (CCV)	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for SPCCs: VOCs≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. SVOCs ≥ 0.050. 2. %Difference/Drift for all target compounds and surrogates: VOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		

[1] Refer to **Worksheet #23** for a complete reference to relevant analytical SOPs.

SAP Worksheet #24-2: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
LC/MS/MS(SW-846 8330B)	Initial Calibration (ICAL) - minimum five-points for all analytes	ICAL prior to sample analysis. Once calibration curve or line is generated, the lowest calibration standard must be reanalyzed.	The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear regression is used, $r \geq 0.995$. If using Internal Standardization, RSD ≤ 15%.	Correct problem then repeat ICAL.	Analyst	GL-OA-E-068
	Second Source Calibration Verification (ICV)	Immediately following ICAL.	All project analytes and surrogates within ± 20% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ± 20% of the expected value from the ICAL.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		

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

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

SAP Worksheet #24-3: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
LC/MS/MS (SW846 6850)	Initial Calibration (ICAL)	Minimum of five calibration standards to establish linearity at method set-up and after major maintenance.	r ≥ 0.995 or RSD ≤ 20%. The concentration corresponding to the absolute value of the calibration curve's Y-intercept must be ≤ LOD.	Correct problem then repeat ICAL.	Analyst	GL-OA-E-067
	Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard at the midpoint of the calibration.	Within ±15% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	Continuing Calibration Verification (CCV)	Analysis of mid-level standard after every 10 field samples. All samples must be bracketed by the analysis of a standard demonstrating that the system was capable of accurately detecting and quantifying perchlorate.	Within ±15% of true value.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
	Tuning	Prior to ICAL and after any mass calibration or maintenance is performed.	Tuning standards must contain the analytes of interest and meet acceptance criteria outlined in the laboratory SOP.	Retune instrument. If the tuning will not meet acceptance criteria, an instrument mass calibration must be performed and the tuning redone.		
LC/MS/MS (SW846 6850) (cont.)	Limit of Detection Verification (LODV) (per batch)	Prior to sample analysis and at the end of the analysis sequence. It can be analyzed after every 10 samples in order to reduce the reanalysis rate.	Within ± 30% of true value.	Correct problem and rerun LODV and all samples analyzed since last successful LODV. If a sample with perchlorate concentration at or between the LOD and RL is bracketed by a failing LODV, it must be reanalyzed. A sample with concentration above the RL can be reported.		
	Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis. The mass calibration is updated on an as-needed basis (e.g., QC failures, ion masses show large deviations from known masses, major instrument maintenance is performed, or the instrument is moved).	Mass calibration range must bracket the ion masses of interest without greatly exceeding the range. The most recent mass calibration must be used for an analytical run, and the same mass calibration must be used for all data files in an analytical run. Mass calibration must be verified by acquiring a full scan continuum mass spectrum of a perchlorate stock standard. Perchlorate ions should be within ± 0.3 m/z of mass 99, 101, and 107 or their respective daughter ion masses (83, 85, and 89), depending on which ions are quantitated.	If the mass calibration fails, recalibrate. If it still fails, consult manufacturer instructions on corrective maintenance.		

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

SAP Worksheet #24-4: Analytical Instrument Calibration Table

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

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

SAP Worksheet #24-5: Analytical Instrument Calibration Table

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

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

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

SAP Worksheet #24-6: Analytical Instrument Calibration Table

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

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

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

SAP Worksheet #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
GC/MS (VOCs and SVOCs)	Clean sources, maintain vacuum pumps.	Tuning.	Instrument performance and sensitivity.	Service vacuum pumps twice per year, other maintenance as needed.	Tune and CCV pass criteria.	Recalibrate instrument.	Analyst/ Supervisor	VGCMS-05 and SVGCMS-03
	Change septum, clean injection port, change or clip column, install new liner, change trap.	Sensitivity check.	Instrument performance and sensitivity.	Daily or as needed.	Tune and CCV pass criteria.	Re-inspect injector port, cut additional column, re-analyze CCV, and re-calibrate instrument.		
HPLC/DAD (Explosives)	Change analytical column as needed; change mobile phase when insufficient for run or contamination; change inlet filters as needed for contamination.	Calibration, ICV, CCV.	Check pump pressure; check for leaks; check for adequate mobile phase.	Prior to initial calibration or as necessary.	Calibration criteria are met.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	GL-OA-E-033
LC/MS (Perchlorate)	Change analytical column as needed; change mobile phase when insufficient for run or contamination; change inlet filters as needed for contamination.	Calibration, ICV, CCV, Interference Check and LODV.	Check pump pressure; check for leaks; check for adequate mobile phase.	Instrument receipt; instrument change (new column, etc.); when continuing calibration verification (CCV) does not meet criteria.	Calibration criteria are met.	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/ Supervisor	GL-OA-E-067

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-AES (Metals)	Change tubing.	None.	None	Every other run.	None.	None.	Analyst/ Supervisor	MET-05
	Clean air filter.	Look at air filters.	Visual	Monthly.	Filter looks clean.	Clean air filters and monitor instrument.		
	Clean injector.	Look at injector to see if dirty.	Visual, but may show with increased carry-over.	As needed.	None.	None.		
	Clean lenses.	Look at lenses.	Monitor peak intensities, look at lenses.	As needed.	Lenses are clean.	Clean lenses.		
CVAA (Mercury)	Replace disposables, flush lines.	Sensitivity check.	Instrument performance and sensitivity.	Daily or as needed.	CCV pass criteria.	Recalibrate.	Analyst/ Supervisor	MET-16
	Clean lens.	Sensitivity check.	Instrument performance and sensitivity.	Daily or as needed.	Method Blank passes criteria.	Recalibrate.		
	Replace pump tubing.	Flow Rate Check.	Instrument performance and sensitivity.	As needed.	Monitor flow rate for variation.	Replace windings, recalibrate and re-analyze.		
Spectrophotometer (Hexavalent Chromium)	Clean reagent tubes. Change lamp.	Initial Calibration Verification	Check wavelength	At the beginning of every run.	CCV pass criteria.	Recalibrate and/or perform the necessary equipment maintenance. Check the calibration standards. Reanalyze the affected data.	Analyst/ Supervisor	WETS-065

SAP Worksheet #26: Sample Handling System

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

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SAP Worksheet #27: Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled. Labels will be taped to the jar to ensure they do not separate. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples 0-6 °C until they are received by the laboratory.

The chain of custody (CoC) form will be placed into the cooler in a Ziploc bag. Coolers will be taped up and shipped to the laboratories via Fed Ex overnight, with the air bill number indicated on the COC (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples to CH2M HILL.

See **Worksheet #21** for CH2M HILL SOPs containing sample custody guidance.

The CH2M HILL field team will ship all samples directly to the laboratory performing the analysis, refer to **Worksheet #30**.

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Laboratory custody procedures can be found in SOP LOGIN-03 and GL-SR-E-001, which are referenced in **Worksheet #23**.

Sample Identification Procedures:

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservation, and sampler's initials. The field logbook will identify the sample ID with the location and time collected and the parameters requested. Sample IDs will conform to the nomenclature specified in **Worksheet #18**. The laboratory will assign each field sample a laboratory sample ID based on information in the chain of custody. The laboratory will send sample log-in forms to the PC and PDM to check that sample IDs and parameters are correct.

Chain-of-custody Procedures:

Chain of custodies will include, at minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID. Date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain of custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management System (LIMS) database for each sample.

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SAP Worksheet #28-1: Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil, Sediment, Surface Soil Composite, Surface Soil Incremental
Analytical Group: Explosives
Analytical Method/SOP Reference: SW-846 8330A / GL-OA-E-033

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. Blank results must not otherwise affect sample results.	Correct the problem, then see Department of Defense (DoD) Quality Standards Manual (QSM) v4.1 Box D-1.If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Same as Method Acceptance Limits
Laboratory Control Sample (LCS)		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15.	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Same as Method Acceptance Limits
Matrix Spike/Matrix Spike Duplicate (MS/MSD)		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. Relative Percent Difference (RPD) <30%	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Same as Method Acceptance Limits
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	Same as Method Acceptance Limits
Surrogates	All field and QC samples.	1-chloro-3-nitrobenzene 55%-140%	Re-prepare and reanalyze all failed samples in the associated preparatory batch for confirmation of matrix interference.		Accuracy / Bias	Same as Method Acceptance Limits

SAP Worksheet #28-2: Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil, Sediment, Surface Soil Composite, Surface Soil Incremental
Analytical Group: Perchlorate
Analytical Method/SOP Reference: SW-846 6850/ GL-OA--067

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

SAP Worksheet #28-3: Laboratory QC Samples Table

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

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	Same as Method Acceptance Limits
LCS		Percent recoveries must meet control limits 80%-120%	Re-prepare and analyze all associated samples.		Accuracy/ Bias	Same as Method Acceptance Limits
MS/MSD		Percent recoveries must meet control limits 80%-120% and RPD of 20%.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Same as Method Acceptance Limits
Serial Dilution	One is performed for each preparation batch with sample concentration(s) > 50x LOQ.	The 5-fold dilution result must agree within ± 10% of the original sample result.	Perform Post Digestion Spike		Precision / Accuracy	Same as Method Acceptance Limits
Post Digestion Spike (PDS)	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 samples in the preparatory batch by method of standard additions or qualify results.		Precision / Accuracy	Same as Method Acceptance Limits

SAP Worksheet #28-4: Laboratory QC Samples Table

Matrix: Surface Soil, Surface Soil Composite, Subsurface Soil, Surface Soil Composite, Surface Soil Incremental

Analytical Group: Mercury

Analytical Method / SOP Reference: SW-846 7471B / MET-16

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

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

SAP Worksheet #28-5: Laboratory QC Samples Table

Matrix: Surface Soil, Surface Soil Composite, Subsurface Soil

Analytical Group: Hexavalent Chromium

Analytical Method / SOP Reference: SW-846 7196A / WETS-64

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Reference Blank (Reagent Water)	Before beginning standards or sample analysis.	N/A	N/A	Analyst	N/A	Same as QC Acceptance Limits.
Method Blank	One per preparatory batch.	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, re-prepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	Same as QC Acceptance Limits.
LCS	One per preparatory batch	Recovery within 70-130%.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated batch for the failed analyte in all samples in the associated preparatory batch, if sufficient sample material is available.	Analyst	Accuracy/Bias	Same as QC Acceptance Limits.
MS	Once for every sample matrix analyzed.	Same as LCS.	If check indicates interference, dilute and reanalyze sample; persistent interference indicates the need to use alternative method or analytical conditions, or to use method of standard additions.	Analyst	Accuracy/Bias	Same as QC Acceptance Limits.
MSD	One per preparatory batch per matrix.	Same as MS and ≤ RPD 30%.	Examine the project-specific DQOs. Contact the client as to additional measure to be taken. Flagging criteria are not appropriate.	Analyst	Accuracy/Bias	Same as QC Acceptance Limits.
PDS	One per preparatory batch.	Same as LCS.	Correct problem and re-homogenize, re-digest, and reanalyze samples. Persistent interference indicates the need to use an alternative method or analytical conditions, or to use method of standard additions.	Analyst	Accuracy/Bias	Same as QC Acceptance Limits.

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

SAP Worksheet #28-6: Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: VOA
Analytical Method/SOP Reference: SW-846 8260B / VGCMS-05

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	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ.	Correct problem; then repeat. If the method blank still fails, repeat initial calibration.	Analyst	Bias/Contamination	Same as QC Acceptance Limits.
LCS		Refer to Worksheet #15.	LCS is reanalyzed. If still fails, samples along with QC, are re-prepped and re-analyzed. Client will be contacted for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.
MS		Same as LCS.	In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.
MSD		Same as LCS and RPD ≤30%.	In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.
IS	Spiked in Every Sample	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	Same as QC Acceptance Limits.
Surrogates		Dibromofluoromethane 85-115%, Toluene-d_8 85-120%, 1,2-Dichloroethane-d4 70-120%, 4-Bromofluorobenzene 75-120%	Re-prep and re-analyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.

SAP Worksheet #28-7: Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: SVOA
Analytical Method/SOP Reference: SW-846 8270D/ SVGCMS-03

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.	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ.	Correct problem. If required, re-prep and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	Same as QC Acceptance Limits.
LCS		See Worksheet #15.	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and re-analyzed. Client will be contacted for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.
MS		Same as LCS.	In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.
MSD		Same as LCS and RPD ≤30%.	In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.
Surrogate Spike	Spiked in every sample.	2-Fluorobiphenyl 50-110%, Terphenyl-d_{14} 50-155%, Nitrobenzene-d_5, 40-110%.	Re-prep and re-analyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	Same as QC Acceptance Limits.
IS	Spiked in every sample.	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions; mandatory re-analysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-8: Laboratory QC Samples Table

Matrix: Surface water, Groundwater
Analytical Group: Explosives
Analytical Method/SOP Reference: SW-846 8330A/ GL-OA-E-033

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. Blank results must not otherwise affect sample results.	Correct the problem, then see Department of Defense (DoD) Quality Standards Manual (QSM) v4.1 Box D-1.If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Same as Method Acceptance Limits
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Table 5B-1	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Same as Method Acceptance Limits
MS/MSD		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. Relative Percent Difference (RPD) <30%	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Same as Method Acceptance Limits
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	Same as Method Acceptance Limits
Surrogates	All field and QC samples.	1-chloro-3-nitrobenzene 40%-145%	Re-prepare and reanalyze all failed samples in the associated preparatory batch for confirmation of matrix interference.		Accuracy / Bias	Same as Method Acceptance Limits

SAP Worksheet #28-9: Laboratory QC Samples Table

Matrix: Surface Water, Groundwater
Analytical Group: Perchlorate
Analytical Method/SOP Reference: SW-846 6850/ GL-OA--067

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

SAP Worksheet #28-10: Laboratory QC Samples Table

Matrix: Surface Water, Groundwater
Analytical Group: Total and Dissolved Chromium
Analytical Method / SOP Reference: SW-846 6010B / MET-05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.1) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1 . If required, re-prepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	Same as QC Acceptance Limits.
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOQ.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst	Accuracy/Bias, Contamination	Same as QC Acceptance Limits.
Interference Check Solutions (ICS)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all samples.	Analyst	Accuracy/Bias	Same as QC Acceptance Limits.
LCS	One per preparatory batch.	Recovery 80-120%. Limits are as per DoD QSM v. 4.1.	Correct problem, then re-prepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	Same as QC Acceptance Limits.
MS	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects.	Analyst	Accuracy/Bias	Same as QC Acceptance Limits.
MSD	One per preparatory batch per matrix.	Same as MS and RPD ≤ 20%.	Same as MS.	Analyst	Accuracy/Bias, Precision	Same as QC Acceptance Limits.
Serial Dilution	One per preparatory batch.	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.	Perform post-digestion spike (PDS) addition.	Analyst	Accuracy	Same as QC Acceptance Limits.
PDS	When dilution test fails or analyte concentration in all samples < 50X LOD.	75-125%R	Run all associated samples in the preparatory batch by method of standard additions (MSA). Or, for the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy	Same as QC Acceptance Limits.

SAP Worksheet #28-11: Laboratory QC Samples Table

Matrix: Surface Water, Groundwater

Analytical Group: Total and Dissolved Hexavalent Chromium

Analytical Method / SOP Reference: SW-846 7196A / WETS-64

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

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

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SAP Worksheet #29: Project Documents and Records Table

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

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SAP Worksheet #30: Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical SOPs	Data Package Turnaround Time	Laboratory/Organization[1]	Backup Laboratory/Organization[2]
UXO-11						
Surface Soil, Subsurface Soil, Sediment, Surface Water, Groundwater	Explosives Perchlorate	Refer to **Worksheet #18**	Refer to **Worksheet #23**	7 Calendar Days	GEL Laboratories Ann Skradski 2040 Savage Road Charleston, SC (843) 566-8171	TBD
	Hexavalent Chromium (total and dissolved)				ENCO - Orlando Ronnie Wambles 10775 Central Port Drive Orlando, FL (407)-826 5314	
	Chromium (total and dissolved)				ENCO - Jacksonville Ronnie Wambles 4810 Executive Park Court, Suite 111 Jacksonville, FL 32216 (407)-826 5314	
UXO-17						
Groundwater	VOCs SVOCs	Refer to **Worksheet #18**	Refer to **Worksheet #23**	7 Calendar Days	ENCO – Jacksonville	TBD
UXO-11 and UXO-17 Post-Detonation Sampling						
Surface Soil Composite, Surface Soil Incremental	TAL Metals	Refer to **Worksheet #18**	Refer to **Worksheet #23**	7 Calendar Days	ENCO – Jacksonville	TBD
	Explosives Perchlorate				GEL Laboratories Ann Skradski 2040 Savage Road Charleston, SC (843) 566-8171	

Notes:

[1] Laboratories meet accreditation requirements to support project needs, the respective DoD ELAP acceptance letters are provided in **Attachment 4**.

[2] A backup laboratory has not been determined. If circumstances render the subcontracted laboratory unable to perform analytical services, another laboratory will be determined at that time.

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SAP Worksheet #31: Planned Project Assessments Table

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

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

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

SAP Worksheet #32-1—Laboratory CA Form

Person initiating corrective action ________________________ **Date** ________________

Description of problem and when identified: ____

____

____

____

____

Cause of problem, if known or suspected: ____

____

____

____

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

____

____

____

____

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____

____

____

CA implemented by: ________________________ **Date:** ____________

CA initially approved by: ________________________ **Date:** ____________

Follow-up date: ____

Final CA approved by: ________________________ **Date:** ____________

Information copies to:

____

____

____

____

SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: ___ Date: ____________________

Project Location: __ Signature: ____________________

Team Members:

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

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

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

Sample Collection

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

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

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

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

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

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

Yes No 7) Are photographs taken and documented?

Comments ____

____

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 #32-3—SBO Form

<table>
<tr><td colspan="4">Safe Behavior Observation Form</td></tr>
<tr><td colspan="2">Project:</td><td>Observer:</td><td>Date:</td></tr>
<tr><td>Position/Title of worker observed:</td><td></td><td colspan="2">Background Information/comments:</td></tr>
<tr><td>Task/Observation Observed:</td><td colspan="3"></td></tr>
<tr><td colspan="4">❖ Identify and reinforce safe work practices/behaviors
❖ Identify and improve on at-risk practices/acts
❖ Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards
❖ Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)
❖ Positive, corrective, cooperative, collaborative feedback/recommendations</td></tr>
</table>

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

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SAP Worksheet #33: Quality Assurance Management Reports Table

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

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

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

1 IIa=compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]

IIb=comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005

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

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

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

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Surface Soil, Subsurface Soil, Sediment, Surface Water, Groundwater	Explosives	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers that may be used are those presented in *National Functional Guidelines for Organic Data Review* (USEPA, 1999) or *National Functional Guidelines for Inorganic Data Review* (USEPA, 2004), as appropriate. National Functional Guidelines will not be used for validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Nancy Weaver / EDS
		Perchlorate		
		Total Chromium		
		Total Hexavalent Chromium		
	Surface Water and Groundwater	Dissolved TAL Metals		
		Dissolved Hexavalent Chromium		
	Groundwater	VOCs		
		SVOCs		
	Surface Soil Composite, Surface Soil Incremental	Explosives		
		Perchlorate		
		TAL Metals		

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SAP Worksheet #37: Usability Assessment

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

- Non-detected site contaminants will be evaluated to ensure that project required QLs in **Worksheet #15** were achieved. If project quantitation limits (PQLs) were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable.
- During verification and validation steps, data may be qualified as estimated with the following qualifiers: J, , J+, J-, or UJ. These qualifiers represent minor QC deficiencies which will not affect the usability of the data. When major QC deficiencies are encountered, data will be qualified with an R and in most cases is not considered usable for project decisions.
  - J – Analyte present. Reported value may or may not be accurate or precise
  - J- - Analyte present. Reported value may be biased low
  - J+ - Analyte present. Reported value may be biased high
  - UJ - Analyte not detected. Quantitation limit may be inaccurate or imprecise
  - R - Rejected result. Result not reliable.
- Additional qualifiers that may be given by the validator are:
  - N - Tentative Identification. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling efforts
  - NJ - Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity
  - U - Not Detected
- For statistical comparisons non-detect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the most conservative value will be used for project decisions.
- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hardcopy data and qualifiers to the electronic data deliverable. Once the data has been uploaded into the electronic database, another check will be performed to ensure all results were loaded accurately.
- Field and laboratory precision will be compared as RPD between the two results.
- Deviations from the SAP will be reviewed to assess whether CA is warranted and to assess impacts to achievement of project objectives.

SAP Worksheet #37—Usability Assessment (continued)

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

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

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

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

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

Identify the personnel responsible for performing the usability assessment.

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

Figures

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

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

N

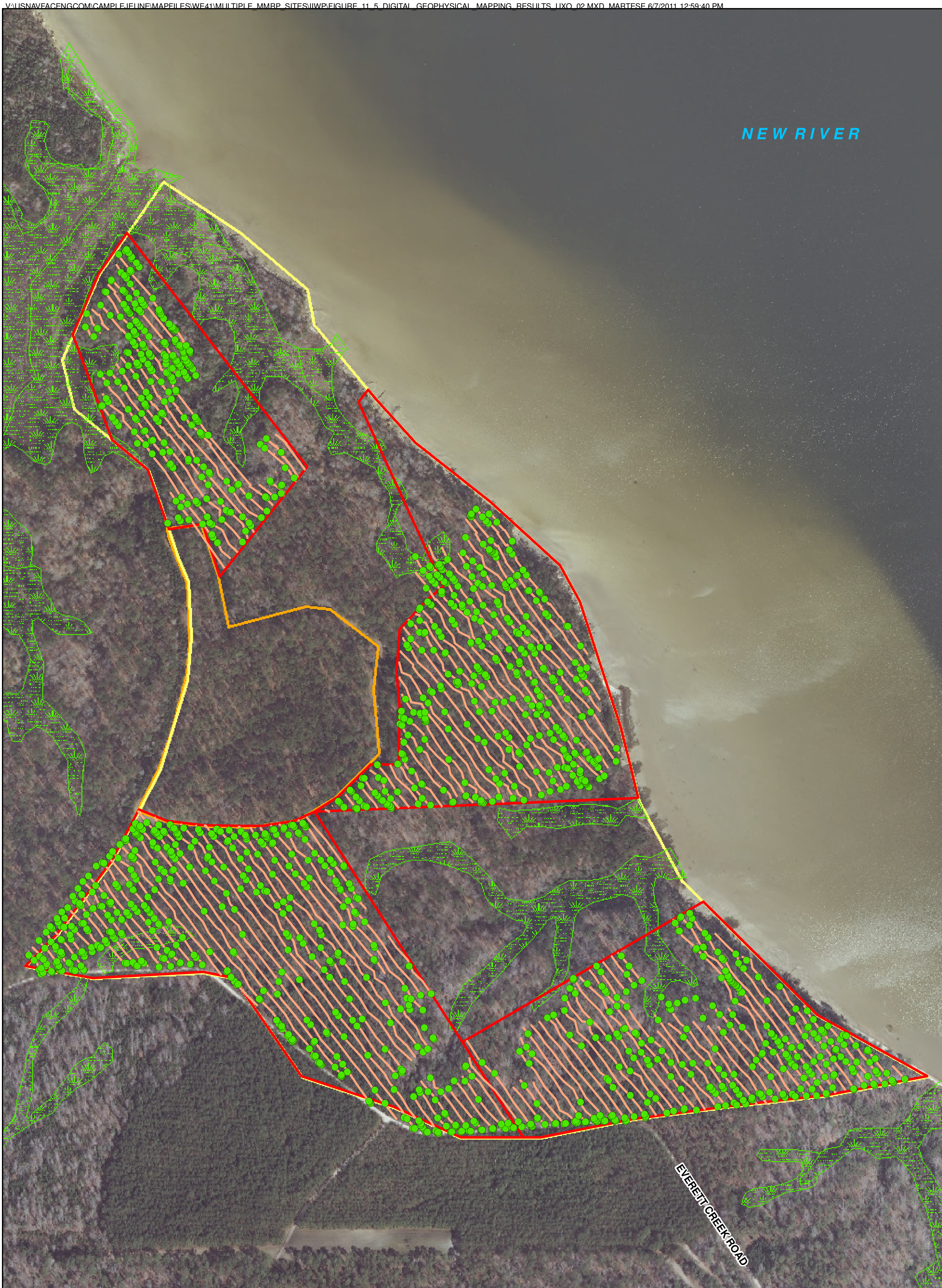
0 750 1,500 Feet

1 inch = 1,500 feet

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

CH2MHILL

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



Legend

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

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 10-2

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

CH2MHILL

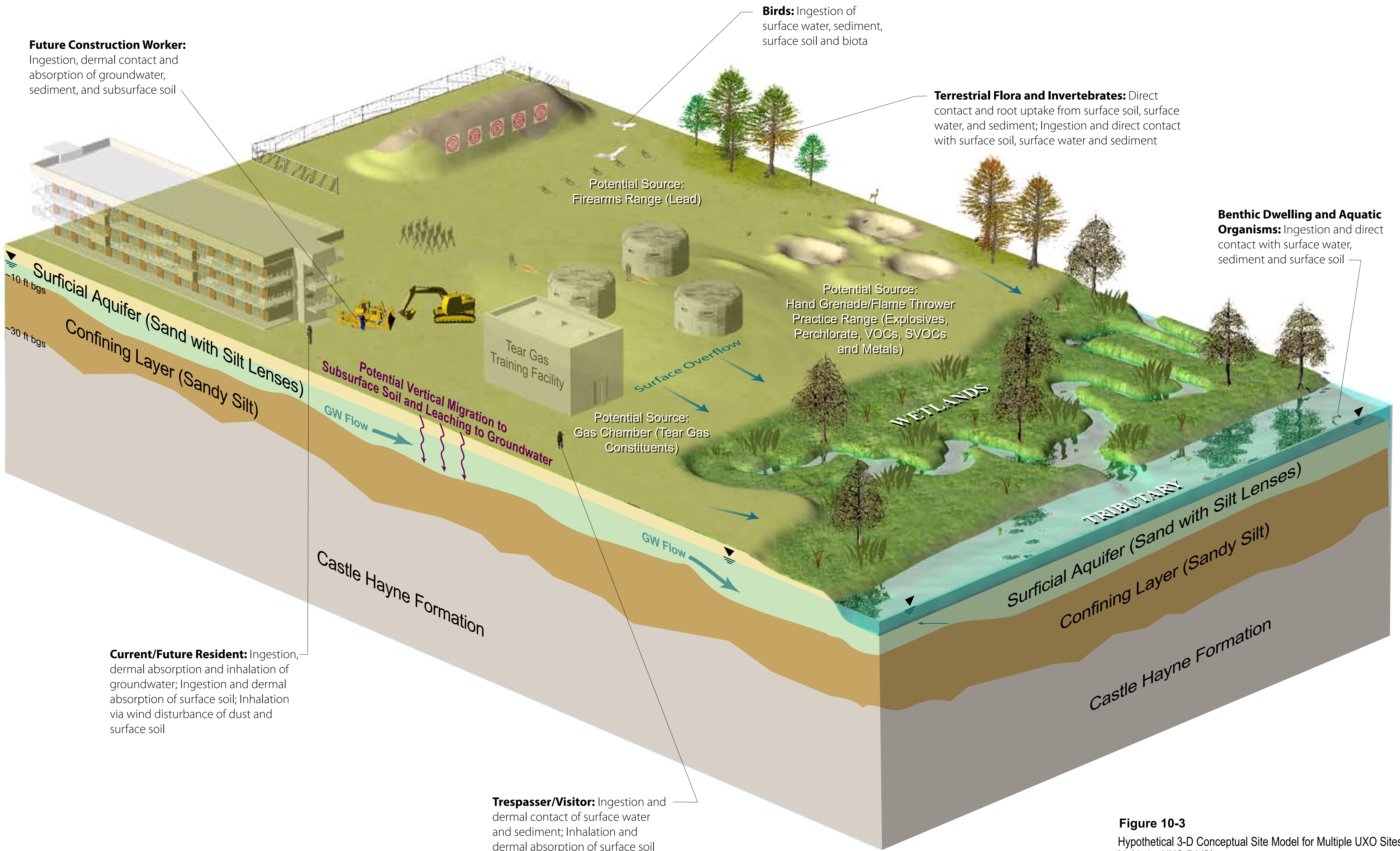


Figure 10-3

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

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

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

N

0 175 350 700 Feet

1 inch = 350 feet

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

CH2MHILL

Legend

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

N

0 175 350 700 Feet

1 inch = 350 feet

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

CH2MHILL

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

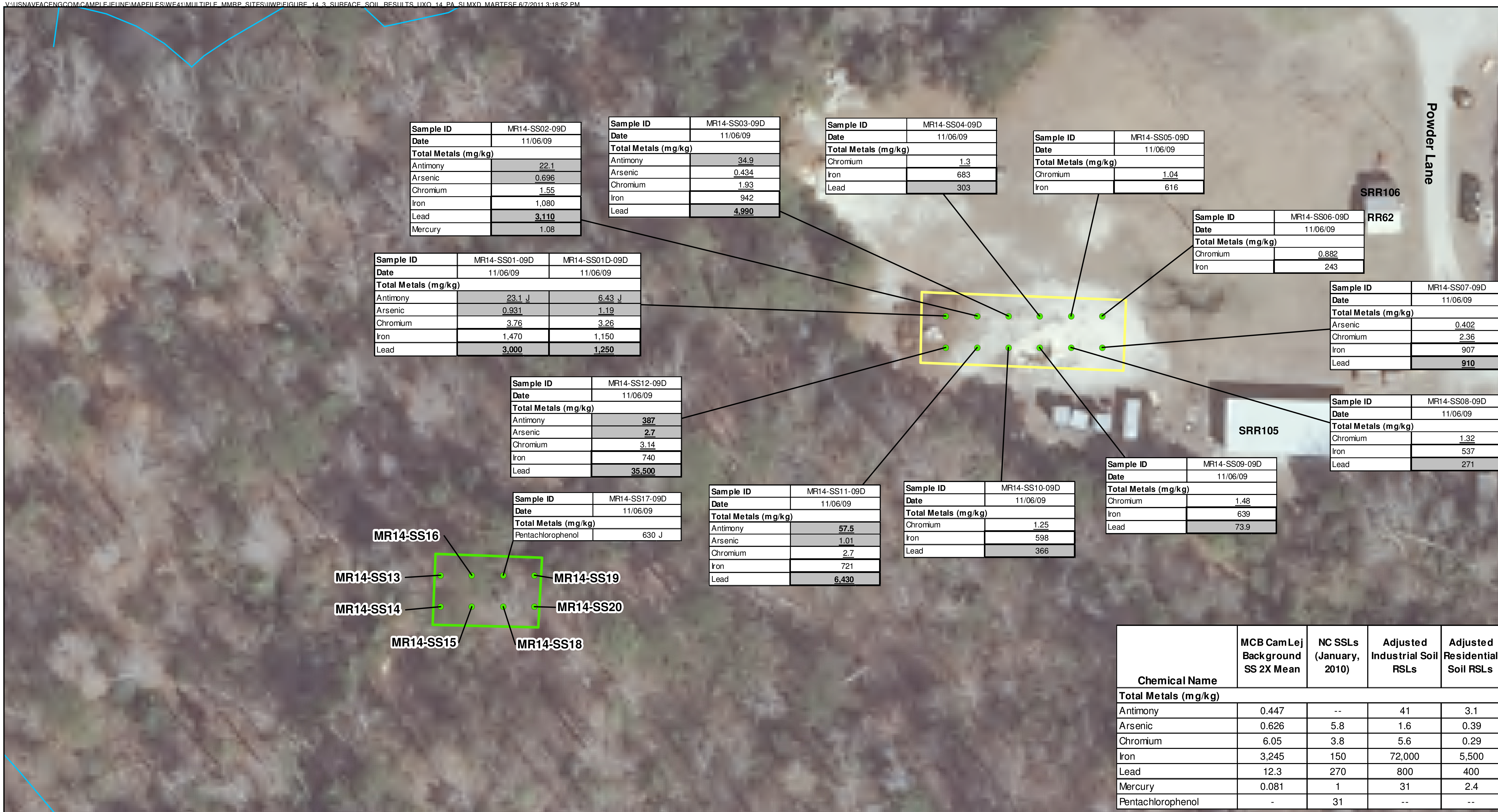
Figure 10-6
UXO-14 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

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

Figure 10-7;
Site UXO-14 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

N

0 25 50 100 Feet

1 inch = 50 feet

Figure 10-8

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

CH2MHILL

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

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

Legend

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

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

N

0 25 50 100 Feet

1 inch = 50 feet

Figure 10-9.
Site UXO-14 Subsurface Soil Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

Legend

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

N

0 25 50 100 Feet

1 inch = 50 feet

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

CH2MHILL

Attachment 1
Standard Operating Procedures—CH2M HILL

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

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

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

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

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

5. Daily entries will be made chronologically.

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

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

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

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

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

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

excessive amounts of dust into the air).

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

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

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

V. Attachments

Example field notes.

Standard Operating Procedure

Locating and Clearing Underground Utilities

I. Purpose

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

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

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

II. Scope

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

Scenario 1

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

Scenario 2

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

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

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

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

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

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

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

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

III. Services and Equipment

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

Services

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

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

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

Equipment

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

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

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

IV. Procedures and Guidelines

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

Activity Notification and Dig Permit Procedures

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

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

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

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

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be

detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

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

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

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

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

IV. Attachments

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

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

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

Proposed Scope of Work

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

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

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

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

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

Field Marking and Documentation

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

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

Bid Sheet/Payment Units

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

Health and Safety Requirements

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

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

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

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

Security

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

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

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

Quality Assurance

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

Subcontractor Standby Time

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

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

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

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

Down Time

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

Schedule

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

Attachment B - Services Available for Identifying and Marking Underground Utilities

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

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

Each are discussed below.

Navy Public Works Department

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

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

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

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

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

Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

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

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

Private Subcontractors

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

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

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

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

Notes:

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

[1]Equipment types are:

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

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.
B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.
C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

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

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

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

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

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

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

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

Ground Penetrating Radar (GPR)

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

Magnetic Field Methods

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

Optical Methods

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

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

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

White – Proposed excavations and borings

Pink – Temporary survey markings

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

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

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

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

Buried Utility Location Tracking Form

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

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

CH2M HILL Purchase Order:

Utility Location Subcontractor:
Subcontractor POC:

Dates of location activities:

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

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

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

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

VOC Sampling-Water

I. Purpose

To provide general guidelines for sampling aqueous volatile organic compounds.

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

1. Sample VOCs before sampling other analyte groups.

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

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

4. Wear clean latex or surgical gloves.

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

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

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

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

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

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

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

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

Where WL_c = Corrected water-level elevation

Wl_a = Apparent water-level elevation

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

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

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

IV. Attachments

None.

V. Key Checks

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

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

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

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Sediment Sampling

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

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

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

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

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

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

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

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

V. Attachments

None.

VI. Key Checks and Items

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

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)

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.

<u>Horiba U22 Calibration procedure:</u>

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.

<u>YSI Calibration procedure:</u>

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

A. Conductivity Calibration:

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

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

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

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

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

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

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

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

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

B. Dissolved Oxygen Calibration:

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

1) Go to the calibrate screen as described in Section

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

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

    NOTE: Be sure to completely immerse all the sensors.

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

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

C. *pH Calibration:*

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

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

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

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

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

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

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

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

D. ORP Calibration:

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

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

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

    NOTE: The sensor must be completely immersed.

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

10) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
11) Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
12) Press **Enter**. This returns you to the Calibrate Screen.
13) Rinse the probe module and sensors in tap or purified water and dry. Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

C. Sample Measurement:

Horiba U22 measurement procedure:

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

YSI measurement procedure:

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

IV. Key Checks and Preventive Maintenance

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

V. References

YSI 556 Multi Probe System Operator Manual

STANDARD OPERATING PROCEDURE

Low-Flow Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Setup and Purging

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

2. Calibrate instruments according to manufacturer's instructions.

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

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

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

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

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

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

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

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

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

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

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

B. Sample Collection

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

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

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

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

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

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly poured from the bailer or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.
3. Inorganics, including metals, may be collected and preserved in the filtered form as well as the unfiltered form. Disposable in-line filters (0.45 micron filter), connected to the end of the sample tubing,, are typically used for field filtration. Samples are field filtered as the water is being placed into the sample container. If a bailer is used, filtration may be driven by a peristaltic pump.

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

5. The bottle is capped and clearly labeled.

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

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

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

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

2. Sample source and source description

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

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

5. Additional remarks

C. Additional remarks

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

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

IV. Attachments

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

V. Key Checks and Preventative Maintenance

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

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

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

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

White Paper on Low-Flow Sampling

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

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

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

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

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

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

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

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

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

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

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

1. Wash boots in Liquinox® solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Liquinox® solution, remove, and discard into DOT-approved 55-gallon drum.

2. Wash outer gloves in Liquinox® solution, rinse, remove, and discard into DOT-approved 55-gallon drum.

3. Remove disposable coveralls ("Tyveks") and discard into DOT-approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. At the end of the work day, shower entire body, including hair, either at the work site or at home.

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

2. Spread plastic on the ground to keep equipment from touching the ground

3. Turn off pump after sampling. Remove pump from well and remove and dispose of tubing. Place pump in decontamination tube.

4. Turn pump back on and pump 1 gallon of Liquinox® solution through the sampling pump.

5. Rinse with 1 gallon of 10% methanol solution pumped through the pump. (DO NOT USE ACETONE).

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.

9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in either DOT-approved 55-gallon drums or with solid waste in garbage bags, dependent on Facility/project requirements.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

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

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

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

E. SAMPLE CONTAINER DECONTAMINATION

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

1. Wipe container with a paper towel dampened with Liquinox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.
2. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/ project requirements.

F. HEAVY EQUIPMENT AND TOOLS

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

1. Set up a decontamination pad in area designated by the Facility
2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

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

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

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

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

B. Downhole Drilling Tools

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

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

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

C. Field Analytical Equipment

1. Water Level Indicators

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

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

2. Probes

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

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

Disposal of Waste Fluids and Solids

I. Purpose and Scope

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

II. Equipment and Materials

A. Fluids

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

B. Solids

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

III. Procedures and Guidelines

A. Methodology

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

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

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

B. Labels

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

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

C. Fluids

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

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

D. Solids

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

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

E. Storage and Disposal

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

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

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

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

STANDARD OPERATING PROCEDURE

Equipment Blank and Field Blank Preparation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

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

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

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

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

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

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

F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

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

II. Scope

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

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

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

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

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

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

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

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

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

G. Fill remaining spaces with vermiculite or absorbent pads.

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

J Close lid and latch.

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

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

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

Medium- and High-Concentration Samples:

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

V. Attachments

None.

VI. Key Checks and Items

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

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.

Click Here For Attachments

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

1.0 Applicability and Scope

1.1 Applicability

This Standard Operating Procedure (SOP) applies to:

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

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

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

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

1.2 Scope

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

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

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

1.3 Regulatory Review

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

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

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

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

2.0 Project Planning

2.1 Planning Requirements

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

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

- On an HTRW site with known or suspected MEC, MEC support involves implementing anomaly avoidance techniques to avoid any potential surface MEC and any subsurface anomalies. A Site Safety & Health Plan (SSHP) must be prepared. This SSHP is to be used only for non-intrusive anomaly avoidance activities, and it must be approved by the MR Safety/Quality Officer, or in his absence the MR Operations Manager or the MR Market Segment Director prior to the start of fieldwork. All team members must read and comply with the SSHP and attend the safety briefings. The UXOSO shall ensure that the Safety Briefing Checklist and Plan Acceptance Form are filled out prior to the start of the site work.

- On a construction site with known or suspected MEC, support must be provided by qualified UXO personnel during construction activities. The level of MEC support required depends on the probability of encountering MEC, determined on a project-by-project basis. This will be identified during the MR (paragraph 17) of the ORE.

- MR actions in which the intent is to locate, identify, excavate, remove, and dispose of MEC may require a Senior UXO Supervisor, UXO Safety Officer, and UXO Quality Control Specialist, to oversee UXO contractor teams performing operations.

- On an MR site that has MC contamination of soil or groundwater, MEC support may include both anomaly avoidance techniques and MEC construction support for excavating and/or treating MC-contaminated soil and groundwater.

- On munitions demilitarization projects, MEC support is required to identify, handle, disassemble, process, certify, transport, and treat or dispose of munitions components.

- On projects where explosives waste is transported or disposed of offsite, the MR Operations Manager and the BG Environmental Compliance Coordinator (ECC) may assist in identifying the applicable regulations and permits required.

- On projects where munitions debris (MD), material potentially presenting an explosive hazard (MPPEH), or inert munitions is recovered and processed for disposal as scrap, the MR Operations Manager and the BG ECC may determine whether treatment and certification is required, along with any permitting requirements.

- For drilling activities at project sites suspected of MEC contamination, the UXO team shall conduct a reconnaissance and MEC avoidance to provide clear access routes to each site before drilling crews enter the area. Down hole avoidance support shall be conducted at intervals every one foot until the depth that was determined during the MR ORE was reached. The procedures listed in HSE-204, *Drilling*, apply and shall be implemented.

- For excavation activities at project sites suspected of MEC contamination, the UXO team shall conduct a reconnaissance and MEC avoidance to provide clear access routes to each site before excavation crews enter the area. The procedures listed in HSE-307, *Excavations*, apply and shall be implemented.

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

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

2.2 Opportunity and Risk Evaluation (ORE)

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

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

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

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

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

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

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

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

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

2.4 Training Requirements

2.4.1 MR Projects

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

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

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

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

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

2.4.2 Commercial Blaster Requirements

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

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

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

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

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

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

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

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

2.5 Medical Surveillance Requirements

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

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

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

2.6 Drug Free Workplace Requirements

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

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

2.7 Competent Person Requirements

2.7.1 Munitions Response

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

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

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

2.7.2 Blasting

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

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

2.8 Safety Equipment

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

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

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

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

2.9 Subcontractor Selection

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

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

3.0 Definitions

Please see **Attachment 3** for definitions.

4.0 Project Execution

4.1 Safe Work Practices

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

4.2 MR Operations

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

4.3 Regulations and Industry Standards

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

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

4.3.1 General Safety Concerns and Procedures

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

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

4.3.2 Explosives Safety Precautions

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

4.3.3 Recognize, Retreat, and Report MEC

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

4.3.4 Explosives Management

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

4.3.5 Explosives Security

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

4.3.6 Controlled Detonation Chamber Operations

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

4.3.7 Explosive Waste Disposal

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

TABLE 4-1
Waste Characterization

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

4.3.8 Forms and Permits

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

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

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

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

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

5.0 Attachments

The following attachments are located within the SOP.

Attachment 1 Abbreviated Site Safety and Health Plan (ASSHP)

Attachment 2 Opportunity Risk Evaluation (ORE)

Attachment 3 Glossary, Acronyms, and Abbreviations

Attachment 4 Explosives Management Check List

6.0 Revision Log

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

CH2MHILL

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

Attachment 1: Abbreviated Accident Protection Plan (AAPP)

For:

Site name ______________________________

Site location ______________________________

Purpose of visit ______________________________

AAPP prepared by ______________________________

Office ______________________________

Address ______________________________

Telephone ______________________________

Date prepared ______________________________

Signature and date ______________________________

AAPP reviewed and approved by:

Safety office: ______________________________ Date: __________

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

I. Site Description and Previous Investigation

A. Site Description

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

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

( ) Unsecured ( ) Inactive

B. Past Uses

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

Yes No –

C. Surrounding Population

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

D. Previous Sampling and Investigation Results

1. MEC Encountered within anticipated boundaries of site

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

Chemical	Concentration	Medium	Location

II. Description of On-Site Activities

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

III. Site Personnel and Responsibilities

Project Manager –

Office ____________________

Address ____________________

Phone ______________________________

Responsibilities ______________________________

Team Leader –

Office ______________________________

Address ______________________________

Phone ______________________________

Responsibilities Responsible for documenting site visit.

UXO Safety Officer –

Office ______________________________

Address ______________________________

Phone ______________________________

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

IV. Hazard Analysis

A. Safety and Health Hazards Anticipated

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

( ) Munitions (specify)

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

B. Overall Hazard Evaluation

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

Justification

V. Accident Prevention

A. General Precautions

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

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

A. Site Rules and Prohibitions

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

B. Material-Handling Procedures

Do not handle.

C. Drum-Handling Procedures

Do not handle.

D. Confined Space Entry

Do not enter.

E. Ignition Source and Electrical Protection

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

F. Spill Containment

N/A

G. Excavation Safety

N/A

H. Illumination

Work during daylight hours only.

I. Sanitation

Use existing sanitary facilities.

J. Buddy System

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

K. Engineering Controls

N/A

L. Heat Stress

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

M. Poisonous Snakes or Insects

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

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

(3) Roll sleeves down and use insect repellant.

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

1. General Information

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

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

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

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

2. On-Site Instructions

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

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

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

d. DO NOT walk across an area where the ground cannot be seen. If dead vegetation or animals are observed, leave the area immediately due to the potential of contamination by a chemical agent.

e. DO NOT drive a vehicle into a suspected MPPEH area; use clearly marked lanes.

f. DO NOT carry matches, cigarettes, lighters, or other flame-producing devices into an MPPEH site.

g. DO NOT rely on color code for positive identification of munitions or their contents.

h. Always assume that MPPEH contains a live charge until it can be determined otherwise.

3. Specific Actions upon Locating MPPEH

a. DO NOT touch, move, or jar MPPEH regardless of its apparent condition.

b. The UXO Safety Officer may approach the item cautiously; take photographs and a full description. Take notes of the markings or any other identifiers.

c. DO NOT be misled by markings on the item stating "practice bomb," "dummy," or "inert." Even practice bombs have explosive charges that are used to mark or spot the point of impact; or the item could be miss-marked.

d. DO NOT roll the item over or scrape the item to identify the markings.

e. The location of any MPPEH found during site investigation should be clearly marked so it can be easily located and avoided.

f. Notify PM upon location of any MPPEH. See Section VIII for phone number.

O. Other

Specify: ____

VII. Site Control and Communications

A. Site Map

Attach copy.

B. Site Work Zones

N/A

C. Buddy System

To be adhered to at all times.

D. Communications

1. On Site

Use verbal communications among team members to communicate to each other on site. If this communication is not possible, develop and use hand signals. Here are some examples:

Hand gripping throat:	"Breathing problems, can't breathe."
Thumbs up:	"OK, I'm all right, I understand."
Thumbs down:	"No, negative."
Hand(s) on top of head:	"Need assistance."
Grab buddy's wrist:	"Evacuate site now, no questions."
One long horn blast:	"Evacuate site to assembly point."
Two short horn blasts:	"Condition under control, return to site."

2. Off Site

Off-site communications shall be established on every site. Communications may be established by using an on-site cellular phone or by locating the nearest public or private phone that may be readily accessed. Mark the appropriate box:

( ) Cellular phone
( ) Public or private phone
( ) Other: ________________

3. Emergency Signals

In the case of small groups, a verbal signal for emergencies shall suffice. The emergency signal for large groups (i.e., air horn) should be incorporated at the discretion of the UXO Safety Officer. Mark the appropriate box:

( ) Verbal
( ) Nonverbal (specify) ____

VIII. Emergency Response

A. Alert Procedures

Team members are to be alert to the hazards associated with the site at all times. If an unanticipated hazardous condition arises, stop work, evacuate the immediate area, and notify the UXO Safety Officer. Practice MEC avoidance. If a suspected MEC is encountered during field activities, the team leader will contact local authorities and USACE Project Manager. The local authorities will contact military EOD. The suspected item will be marked with colored tape (or equivalent) by on-site UXO Safety Officer (escort).

B. First Aid

A first aid kit and emergency eyewash (as applicable) will be located in the UXO Safety Officer's field car. If qualified persons (i.e., a fire department, medical facility, or physician) are not accessible within five minutes of the site, at least one team member shall be qualified to administer first aid and cardiopulmonary resuscitation (CPR).

C. Emergency Telephone Numbers

1. Medical Facility
2. Fire Department

   ____

3. Police Department

   ____

4. Poison Control Center:

   (800) 222-1222

5. Local EOD

   ____

6. Project Manager(s)

   ____

D. Hospital and Medical Facility Information

Route to hospital: (Attach a map with the route to the hospital marked; if a map is not available, then provide clear, written instructions.)

IX. Monitoring Equipment and Procedures

A. Exposure Monitoring

For non-intrusive on-site activities such as site visits, air monitoring is typically not required. However, if the site situation dictates the need for monitoring, then complete the following information on a separate page and attach the page to this AAPP.

Monitoring equipment to be utilized

Documentation of equipment calibration and results

Action levels

B. Heat and Cold Stress Monitoring

If heat stress monitoring is necessary, the monitoring criteria published in Chapter 8 of *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCG/EPA, October 1985) shall be followed. If cold stress monitoring is necessary, it shall be conducted in accordance with the most current American Conference of Governmental Industrial Hygienists (ACGIH) cold stress standard.

X. Personal Protective Equipment

A. General

Typically, for non-intrusive site visits, Level D PPE is required. Hard hats shall be worn if an overhead hazard exists, safety shoes if a foot hazard exists, and safety glasses if an eye hazard exists. If a higher level of protection is to be used initially or as a contingency, attach a brief discussion.

B. Non-intrusive Site Visit

Level of Protection

Initial:	( ) C	( ) D	( ) Modified (specify)
Contingency:	( ) C	( ) D	( ) Modified (specify)
	( ) Evacuate site if higher level of protection is needed.		

XI. Decontamination Procedures

If decontamination is required, attach an additional sheet with the requirements.

Decontamination procedures are not anticipated for this site investigation. Team members are cautioned not to walk, kneel, or sit on any surface with potential leaks, spills, or contamination.

XII. Training

All site personnel shall have completed the training required by EM 385-1-1 and 29 CFR §1910.120 (e). The Project Manager shall ensure, and the UXO Safety Officer shall verify, that all on-site persons have completed appropriate training prior to submitting the plan to the safety office for review. Additionally, the UXO Safety Officer shall inform personnel, before they enter the site, of any potential site-specific hazards and procedures.

XIII. Medical Surveillance Program

The Project Manager shall ensure, and the UXO Safety Officer shall verify, that all on-site personnel are in the Medical Surveillance Program meeting the requirements of 29 CFR §1910.120.

XIV. Logs, Reports, and Recordkeeping

A Site Log will be maintained by the team leader. This record will include historical data, personnel authorized to visit the site, all records, standard operating procedures, the AAPP submitted, any air monitoring logs, SOPs, and attachments to plans. All logs are to be maintained and available for inspection.

XV. General

The number of persons visiting the site shall be held to a minimum. No more than 8 people per UXO Safety Officer shall be allowed on-site. The more persons on site, the greater the potential for an accident. The UXO Safety Officer may modify this AAPP if site conditions warrant it and if it does not risk the safety and health of the team members. This modification shall be coordinated with the team members, and the UXO Safety Officer shall notify PM of the change as the situation allows.

XVI. Natural Resources

The following is a list of threatened and endangered species:

Safety Briefing Checklist
(Check subjects discussed)

Location: ________________________________ Date: ______________________________

General Information

Purpose of visit: ____

Identify key site personnel: ____

Training and medical requirements: ____

Specific Information

Site description and past uses: ____

Results of previous studies: ____

Potential site hazards: ____

MEC safety procedures: ____

Site SOPs: ____

Site control and communications: ____

( ) Emergency Hand Signals

Emergency Response: ____

( ) Location of First Aid Kit

( ) Emergency Phone Numbers and Location

( ) Location of Nearest Medical Facility and Location of Map to Facility

PPE and Decontamination: ____

Note: Stress the following during the briefings: If an unanticipated hazardous condition arises, stop work, evacuate the immediate area, and notify the UXO Safety Officer.

Plan Acceptance Form:
Abbreviated Accident Prevention Plan

For:

I have read and agree to abide by the contents of this Abbreviated Accident Prevention Plan and I have attended the Safety Briefing for the aforementioned site.

Name (printed)	Office	Signature	Date

Person presenting the safety briefing:

Signature Date

Equipment List

(The following items may be necessary to support the site visit)

1. Boots or sturdy leather work shoes.
2. First aid kit.
3. Sun screen lotion.
4. Bug and/or insect repellant.
5. Rain / cold weather protection.
6. Potable water.

CH2MHILL

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

Attachment 2: Opportunity Risk Evaluation (ORE)

1.0 Projects Involving or Potentially Involving the Use of Explosives, Materials Potentially Presenting an Explosive Hazard (MPPEH), Munitions and Explosives of Concern (MEC) and Related Activity.

Administrative Information

Project Name:
Project Number:
Project Location: (Address, City, State, Zip Code, Country)
Address:
City:
State:
Zip Code:
Country:
Project Manager - CH2M HILL:
Contracting Organization:
Client Organization:
☐ Department of Defense
☐ Department of State
☐ Department of Energy
☐ Department of Interior
☐ Other
Client Organization Name:
Contract Type
☐ Time and Materials (T&M)
☐ Cost Plus (CP)
☐ Firm Fixed Price (FFP)
☐ Target Cost Incentive Fee (TCIF)
☐ Guaranteed Fixed Price with Insurance (GFPI)
☐ Performance Based Acquisition (PBA)
☐ Other

Brief Outline of the Scope of Work.

Number and Type of MR Personnel Needed to Support Project.

Any point value of 3, 4 or 5 in Sections A, B, C or D requires that you provide a risk management strategy as indicated. If unable to do so, you may wait until the formal MR ORE is conducted, then add the agreed to strategy at that time. Examples of strategies include, engineering controls, contractual protections, procedures, insurance and bonding, etc.

Level of effort should include MR Group Safety/Quality Control Audits for project over two weeks in field.

If you are unsure of which answer to use, leave blank and the question will be evaluated at length during the MR ORE process.

Upon completion of this form, email to those identified and schedule a telephonic conference call with them to review this document.

Part A:

Common Questions for Explosives Usage, Munitions Response (MR) and Controlled Detonation Chamber (CDC) Projects

Scoring Criteria

0 = none, 1 - 2 = Low Risk 3 Moderate Risk 4 - 5 High Risk

17.A1 Type of Reactive Materials?

Project Risk Category?	Check (x)	Point Value
Small Arms (<.50 cal) Ammunition	☐	0
Commercial Explosives	☐	3
Military Explosives/Energetics (bulk)	☐	3
CWM or CWA	☐	5
Munitions and Explosives of Concern (MEC)	☐	5
Pyrotechnics (including fire-works, etc.)	☐	5

RISK MANAGEMENT STRATEGY:

17.A2 Client – End Land Use

Which factor best describes the project end land use?	Check (x)	Point Value
Like Use -	☐	0
Not Yet Determined -	☐	1
Limited Public Access - livestock grazing/wildlife preserve/historic area	☐	2
Public Access - Farming/Agriculture	☐	3
Unrestricted – Commercial	☐	4
Unrestricted – Residential	☐	5

RISK MANAGEMENT STRATEGY:

17.A3 Chemical Warfare Material (CWM)

Which factor best describes this risk factor?	Check (x)	Point Value
None	☐	0
No-specific reference - but possible	☐	3
CW Agents Known or Suspected	☐	5
CW Munitions Known or Suspected	☐	5

RISK MANAGEMENT STRATEGY:

)

17.A4 Who will write the Work & Safety Plans?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
CH2M HILL (Who in CH2M HILL ?)	☐	1
Don't Know	☐	3
Client / Subcontractor	☐	5

RISK MANAGEMENT STRATEGY:

17.A5 Does Client acknowledge that it will retain ownership of, and responsibility for MEC & recovered items ?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.A6 Does the Project Delivery Team have a history of successful execution of this type of project?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know?	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.A7 Is the Client responsible for obtaining necessary permits such as utility locator, state authorizations, rights of entry, etc.?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

)

17.A8 Will there be a range debris, munition debris, etc., recovery effort?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17. A9 Will CH2M HILL subcontract MR or explosive operational actions?

Which factor best describes this risk factor?	Check (x)	Point Value
No	☐	0
Munitions Response Master Services Agreement (MSA)	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.A10 For "removal" activities, will "blow-in-place" (BIP) be permitted?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No.	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.A11 Is CH2M HILL responsible for the preparation of client-owned solid waste and hazwaste? (with Client's manifest)?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

)

17.A12 Will we need to order explosives for this project? Who will initiate the order?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Government Furnished	☐	1
CH2M HILL	☐	3
UXO Contractor	☐	5

RISK MANAGEMENT STRATEGY:

17.A13 Is explosives storage required and/or available on site? If yes, who provides?

Which factor best describes this risk factor?	Check (x)	Point Value
Government Provided	☐	0
CH2M HILL	☐	2
UXO Subcontractor	☐	3
Unknown	☐	5

RISK MANAGEMENT STRATEGY:

17.A14 Could weather conditions effect this project?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes.	☐	5

RISK MANAGEMENT STRATEGY:

17.A15 Is geophysical investigation required on this project?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Geophysical Prove Out required?	☐	3
Geophysical System Verification?	☐	5
	☐	

RISK MANAGEMENT STRATEGY:

)

17.A16 Are there public transportation routes, airport, mariners operations, rail roads, etc., within 2000 ft. to the site? If so, provide distances in feet.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.A17 Are two types of communications available on this project site? Both will need to be added to the Safety Plan and exercised prior to each day activity.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes	☐	1
Don't Know	☐	3
No	☐	5

RISK MANAGEMENT STRATEGY:

17.A18 Are there emergency response services in close (5 minutes) proximity to project site (e.g., fire, hospital)?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.A19 Are there sensitive environment issues that need to be considered? Training of the UXO Technicians may be required.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

PART B:

Explosives Usage Project Questions

17.B1 Source of explosives

Which factor best describes the source?	Check (x)
Vendor - Authorized ATF&E Dealer	☐
Government Furnished	☐
Client Furnished	☐
Subcontractor Provided	☐
Transferred from another CH2M HILL project	☐

RISK MANAGEMENT STRATEGY:

17.B2 Explosive operations general RISK requirements/concerns

Which factors apply to regulatory conformance risk factor?	Check (x)
State Blasting License (Individual)	☐
State Blasting License (Corporation)	☐
State Explosive Storage Permit (Fire Marshal Inspection)	☐
Vehicle Inspection (state of registration) for hazard materials transportation	☐
Hazard Materials License (federal and or state)	☐
Operator – Commercial Drivers License with Hazmat Endorsement	☐
Airport/flight paths – Notice to Airmen (NOTAM) – Airspace	☐
Navigable Waterways – Notice to Mariners (NOTM)	☐
Power lines/ Radar/ Microwave tower/Antenna – Electro Magnetic Radiation Hazards	☐
Military - training corridor/area/test area/research and development area	☐
Need to establish a Temporary Open Detonation Area	☐
Need to establish an Explosive Holding Area	☐
Need to establish an Explosive Inspection Area for MPPEH/MDAS	☐
Need to establish a storage area for MEC	☐
Need to establish a storage area for MPPEH	☐

RISK MANAGEMENT STRATEGY:

)

17.B3 Explosive Storage Risk Factors

Which factor best describes this risk factor - Magazine Condition?	**Check (x)**	**Check (x)**
Not Applicable.	☐	0
Fire Inspector Permit/electrical grounding tests, ventilator and doors and locks and hasps IAW NFPA Code 495	☐	1
Do Not Know	☐	3
Unknown construction (material, etc.)	☐	5

RISK MANAGEMENT STRATEGY:

17.B4 Explosive Transportation

Which factor best describes this risk factor?	**Check (x)**	**Check (x)**
Not Applicable.	☐	0
Within project area – private roads	☐	1
Public Roads	☐	3
Federal Roads (interstate - DOT) or over water (USCG)	☐	5

RISK MANAGEMENT STRATEGY:

17.B5 Explosive Security

Which factor best describes this risk factor?	**Check (x)**	**Point Value**
Not Applicable.	☐	0
Provided by Military	☐	1
Provided by Others	☐	3
Don't Know	☐	3
Provided by CH2M HILL	☐	5

RISK MANAGEMENT STRATEGY:

17.B6 Is underwater work required?

Which factor best describes this risk factor?	**Check (x)**	**Point Value**
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

PART C:

Munitions Response Project Questions

17.C1 Type of Munitions Response (MR) project.

Which factor best describes this risk factor?	Check (x)	Point Value
Desk top studies – no site visit	☐	0
Escort and/or Avoidance Activities – (site visit, reconnaissance, sediment sampling, develop wells, perform O&M, land survey, area preparation, design work, etc.)	☐	1
Construction Support – Direct Push, Trenching, Excavation, Soil Sifting, Insitu-treatment, Demolition, Land Clearing/grubbing etc.)	☐	2
Demilitarization/ MPPEH/ Blasting/	☐	3
Removal Action	☐	4
Demining, Improvised Explosive Devices (IED)	☐	5

RISK MANAGEMENT STRATEGY:

17.C2 Is "over water" (on boat, bridge, etc.) work required?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Unknown	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.C3 Type of Munitions Constituents (MC) contaminated soil and/or groundwater

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Low concentrations of explosives measured in ppb/ppm.	☐	1
High Concentrations of explosives measured in ppb/ppm.	☐	2
High Concentrations of explosives measured in ppb/ppm - No explosive hazard.	☐	3
Soil with 5% to 10% Energetic Material by Weight - Initiation Hazard.	☐	4
Soil with >10% Energetic Material by Weight - Explosive Hazard.	☐	5

RISK MANAGEMENT STRATEGY:

)

17.C4 Type of munitions demilitarization.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Discarded Military Munitions (DMM).	☐	1
MEC Unfuzed.	☐	2
MEC Fuzed (BIP)	☐	3
MD	☐	4
Deteriorated material.	☐	5

RISK MANAGEMENT STRATEGY:

17.C5 Are we to submit an Explosives Siting Plan (ESP), Explosive Safety Submission (ESS) for the Client? (CSS for RCWM).

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.C6 Is the Munitions Response Area (MRA) secured?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes	☐	1
Don't Know	☐	3
No	☐	5

RISK MANAGEMENT STRATEGY:

17.C7 Self Performance?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	**0**
Avoidance Support	☐	**0**
Vegetation Removal	☐	**1**
Geophysical Survey	☐	**2**
Investigaton/MPPEH Processing	☐	**3**
Removal	☐	**4**
Demolition	☐	**5**

RISK MANAGEMENT STRATEGY:

PART D:

Controlled Detonation Chamber (CDC) Project Questions

17.D1 Type of MEC Hazard

Which factor best describes this risk factor?	Check (x)	Point Value
Small Arms Ammunition < 0.50 cal.	☐	0
Demilitarization	☐	1
MEC/MPPEH/Bulk Explosives	☐	3
Fireworks/pyrotechnics	☐	4
Chemical Warfare Materiel (CWM)	☐	5

RISK MANAGEMENT STRATEGY:

17.D2 Quality and Completeness of Inventory

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Inspection and Verification by CH2M HILL.	☐	1
Inspection/Certification/Verification by Others	☐	3
Client Statement.	☐	5

RISK MANAGEMENT STRATEGY:

17.D3 MEC/MPPEH

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Meets CDC ESS limitations	☐	1
CWM	☐	3
Munitions requiring disassembly (i.e., water cutting, etc.)	☐	5

RISK MANAGEMENT STRATEGY:

)

17.D4 Will CH2M HILL provide CDC operator services?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.D5 If CDC leased to Owner, will CH2M HILL train Client operators?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.D6 Will Owner accept CH2M HILL rejection of MEC deemed unsuitable for CDC destruction?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.D7 Are all items of type, size and condition previously destroyed in CDC?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

CH2MHILL

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

Attachment 3: Glossary, Acronyms, and Abbreviations

Active munitions inventory (or stockpile): The supply of chemical and conventional military munitions that is available for issue and use for combat, training, demonstrations, research, development, testing, or evaluation. (See **munitions stockpile** and **demilitarization inventory**.)

Active range: An operational military range that is currently in service and being regularly used for training, demonstrations, research, development, testing, or evaluation.

AEDA: ammunition, explosives, and dangerous articles.

Anomaly avoidance: Techniques employed by EOD or UXO personnel at sites with known or suspected MEC to avoid any potential surface MEC or subsurface anomalies. This usually occurs at mixed-hazard sites when HTRW investigations must occur before an MEC removal action is executed. Intrusive anomaly investigations are not authorized during MEC avoidance operations.

Anomaly: Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and nonferrous material at a site.

AP: armor piercing: Munitions that may or may not contain HE and are designed to penetrate hard targets.

APERS: antipersonnel munitions: May be loaded with high explosives or incendiary fillers and are designed to kill, wound, or obstruct personnel.

APT: armor-piercing tracer: Munitions, designed to penetrate hard targets, that contain a pyrotechnic element that produces bright light and/or smoke to aid in visual tracking of the munitions in flight.

ATV: all-terrain vehicle.

Authorized Visitors: Government or contractor personnel conducting project or mission related functions, e.g., Quality Assurance Representatives (QAR's) safety and quality inspectors (including geophysicists performing quality assurance functions) and project management. Authorized visitors must be escorted while in the EZ and be approved for entry into the EZ. No more than two visitors will be permitted in the EZ at any one time.

BD: base detonating: Impact fuze designed to function when the projectile comes in contact with the surface of the target. The fuze is located in the base or tail of the munitions.

bgs: below ground surface.

BRAC: Base Realignment and Closure.

CAD: cartridge-actuated device: An explosive device designed to produce gas pressure to expel or eject an item.

Cal: caliber: The diameter of a projectile or the bore of a weapon (i.e., .50-cal, 3-inch, 90-millimeter).

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act.

Chemical Warfare Materiel (CWM): An item configured as ammunition, containing a chemical substance intended to kill, seriously injure, or incapacitate a person through its physiological effects. Also includes V- and G-series nerve agents, H-series blister agent, and lewisite in other-than-munitions configurations. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include riot control agents, chemical herbicides, smoke- and flame-producing items, or soil, water, debris, or other media contaminated with a chemical agent.

Closed range: A military range that has either been taken out of service as a range and has been put to new uses that are incompatible with range activities, or that is no longer considered to be a potential range area. A closed range is still under the control of a DOD component.

Construction support: Support provided by qualified UXO personnel during construction activities at potential MR sites to ensure the safety of construction personnel from the harmful effects of MEC. When it is determined that the probability of encountering MEC is low (current or previous land use leads to a determination that MEC may be present), a two-person UXO team will stand by in case the construction contractor encounters a suspected MEC. When it is determined that the probability of encountering a MEC is moderate to high (current or previous land use leads to a determination that MEC was employed or disposed of in the parcel of concern, e.g., open burn and open detonation areas), UXO teams are required to conduct subsurface MEC clearance for the known construction footprint, either in conjunction with the construction contractor or before construction.

Controlled Detonation Chamber (CDC): The CDC is a system for controlled detonation of MEC and MEC-related materials. It is capable of repeated controlled detonations of a suite of energetic materials that are currently demilitarized by OB/OD. This offers the DOD an alternative to OB/OD while at the same time increasing throughput, efficiency, and safety and controlling air, soil, water, and noise pollution. The CDC system meets all state and federal air discharge regulations.

CQC: Contractor Quality Control.

CTT: closed, transferring, and transferred (refers to a subset of military ranges).

DAC: Defense Ammunition Center.

DDESB: Department of Defense Explosives Safety Board.

DERP: Defense Environmental Restoration Program.

Demilitarization (“demil”): The process that removes the military characteristics from unused munitions that are either unsuitable for continued storage, excess to DOD needs, or about to be released from DOD control. Demilitarization applies equally to munitions in unserviceable or serviceable condition. Used (i.e., fired) munitions items also sometimes undergo demilitarization. There are many demilitarization methods, such as recovery, recycling, remanufacture, disassembly, reclamation, mutilation, alteration, melting, burning, detonating, destruction, treatment, and disposal. Methods involving R3 currently constitute approximately two-thirds of the DOD demilitarization programs.

Demilitarization (demil) inventory: The demilitarization inventory consists of excess, obsolete, and unserviceable munitions. Munitions are moved from the active inventory to the demilitarization inventory after it is determined that they are not economically repairable, they are obsolete, or they are excess to DOD needs and cannot be sold under the Foreign Military Sales program. (Also see **active munitions inventory** and **munitions stockpile**.)

DENIX: Defense Environmental Network and Information Exchange.

Department of Defense Components: The Office of the Secretary of Defense, the Military Departments and Services, the Joint Staff, the Unified and Specified Combatant Commands, the Defense Agencies, the DOD Field Activities, and the National Guard.

Department of Defense Explosives Safety Board (DDESB): A Joint Service board comprising a chairperson, voting representatives from each of the Armed Services, and a permanent military and civilian secretariat to perform operational and administrative functions. The DDESB provides impartial and objective advice to the Secretary of Defense and DOD components on explosives safety matters. (See DOD 6055.9-STD for a detailed assignment of DDESB functions.)

DGPS: differential global positioning system.

Discarded Military Munitions (DMM): Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2))

DLA: Defense Logistics Agency.

DMM: discarded military munitions.

DOD: U.S. Department of Defense.

DODD: Department of Defense Directive.

DODIG: Department of Defense Inspector General.

DOI: U.S. Department of Interior.

DRMO: Defense Reutilization and Marketing Office.

DRMS: Defense Reutilization and Marketing Service.

EBS: environmental baseline survey.

Emergency Response (to munitions- or explosives-related or UXO emergencies): An immediate response by explosives and munitions emergency response personnel (i.e., DOD EOD personnel) to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. The response action may include in-place or on-site render-safe procedures, treatment, or destruction of the explosives or munitions or their transport to another location where these operations may be conducted. (See 40 CFR Part 260 et seq., the Military Munitions Rule.)

Energetic material: A component or item of ammunition that is designed to produce the necessary energy required for ignition, propulsion, detonation, fire, or smoke, thus enabling the item to function. Also a material (e.g., corrosive or oxidizer) that is inherently dangerous and capable of causing serious damage and that requires regulated handling to avoid accidents in connection with its existence and use.

EOD: Explosive Ordnance Disposal.

EPA: U.S. Environmental Protection Agency.

EPCRA: Emergency Planning and Community Right-to-Know Act.

ERGM: extended-range guided munitions.

ESCA: Environmental Services Cooperative Agreement.

ESOH: Environmental, Safety, and Occupational Health.

ESOHPB: Environmental, Safety, and Occupational Health Policy Board.

Essential personnel. Personnel whose duties require them to remain within an ESQD arc for one or more of the following reasons:

a. Government and project personnel necessary for the safe and efficient completion of field operations conducted in an EZ. This is limited to: contractor work teams members including the Unexploded Ordnance (UXO) Safety Officer (UXOSO), UXO Quality Control Specialist, Senior UXO Supervisor and a USACE Ordnance and Explosives (OE) Safety specialist.

b. Personnel not UXO qualified must be identified in the work plan by name and/or position.

ESTCP: Environmental Security Technology Certification Program.

Exclusion Zone (EZ): A safety zone established around an MR work area. Only project personnel and authorized, escorted visitors are allowed within the EZ. Examples of EZs are safety zones around MEC-intrusive activities and safety zones where MEC is intentionally detonated. (See DDESB-KO, 27 January 1990.)

Explosive Equivalent. The amount of a standard explosive which, when detonated, will produce a blast effect comparable to that which results at the same distance from the detonation or explosion of a given amount of the material for which performance is being evaluated. It is usually expressed as a percentage of the total net weight of all reactive materials contained in the item or system. For the purpose of this manual, TNT is used for comparison.

Explosive Ordnance Disposal (EOD): Includes detecting, identifying, field evaluating, rendering safe, and final disposing of MEC.

Explosive Ordnance Disposal (EOD) Personnel: Military members who have graduated from the Naval School, EOD. They have received highly specialized training to provide time-critical MEC hazard mitigation services during both peacetime and wartime. EOD personnel are trained and equipped to perform render-safe procedures (RSP) on nuclear, biological, chemical, conventional, and improvised explosive devices. (Note that EOD personnel are distinguished from UXO Technicians, who are civilian contractor or government personnel with specialized training and qualifications in the long-term remediation of MEC.)

Explosive Safety Quantity Distance (ESQD): The prescribed minimum distance between sites storing or handling hazard Class 1 explosive material and specified exposures (i.e., inhabited buildings, public highways, public railways, other storage or handling facilities, or ships, aircraft, etc.) to afford an acceptable degree of protection and safety to the specified exposure. The size of the ESQD arc is proportional to the NEW present.

Explosive Safety Submission (ESS): The document that serves as the specifications for conducting work activities at the project. The ESS details the scope of the project, the planned work activities, potential hazards, and the methods for their control.

Explosive Siting Plan (ESP): The document that serves as a DDESB Permit approving the site-specific storage locations, quantities, and safe distances for explosive operations.

Explosive soil: Mixtures of explosives in soil, sand, clay, or other solid media at concentrations such that the mixture itself is explosive. The following also defines an explosive soil: The concentration of a particular explosive in soil necessary to present an explosion hazard depends on whether an explosive is classified as "primary" or "secondary." Primary explosives are those extremely sensitive explosives (or mixtures thereof) that are used in primers, detonators, and blasting caps. They are easily detonated by heat, sparks, impact, or friction. Examples of primary explosives include lead azide, lead styphnate, and mercury fulminate. Secondary explosives are bursting and boostering explosives (i.e., they are used as the main bursting charge or as the booster that sets off the main bursting charge). Secondary explosives are much less sensitive than primary explosives. Soil containing 10 percent or more by weight of any mixture of secondary explosives is considered "explosive soil." Soil containing propellants (as opposed to primary or secondary high explosives) may also present explosion hazards.

°F: degrees Fahrenheit.

FAR: Federal Acquisition Regulations.

FFA: Federal Facilities Agreement.

FFCA: Federal Facilities Compliance Act.

FOST: finding of suitability to transfer.

Frag: fragment or fragmentation: Munitions material projected away from the point of detonation at a high velocity.

Free from explosive hazard: Material that has been inspected for explosives and determined not to present a danger of explosion or combustion from explosive or energetic materiel.

FUDS: formerly used defense site.

GIS: geographic information system.

GPS: global positioning system.

Hazardous waste: A solid waste that meets the following criteria: (1) is or contains a hazardous waste listed in 40 CFR Part 261, or (2) exhibits characteristics of ignitability, corrosivity, reactivity, and/or toxicity. (Refer to 40 CFR § 261.3 for further explanation.)

HE: high explosive: Explosive that normally detonates rather than burns.

HEAT: high-explosive antitank: Munitions designed to defeat armor by the use of a shaped charge.

HEI: high-explosive incendiary: High-explosive-filled munitions with additional ingredients to give a fire-producing effect.

HQMC: Headquarters, U.S. Marine Corps.

ICM: improved conventional munition.

Impact area: The identified area within a range intended to capture or contain ammunition, munitions, or explosives and resulting debris, fragments, and components from various weapon system employments. In simple terms, normally the target area where live-fire rounds or bombs impact the earth.

Improved Conventional Munition (ICM): ICMs or submunitions, cluster bombs, and cargo rounds are considered sensitive-fuzed munitions and require special authority to enter contaminated areas.

Inactive range: An operational military range that is not currently being used but is still under military control, and which the military both considers to be a potential range area and has not put to a new use that is incompatible with range activities. A potential range area is defined as meeting one of three criteria:

(1) Mobilization and force projection: ranges that are held by a DOD component for the purpose of preparing individuals and units for worldwide deployment, redeployments, or demobilization in response to war, stability, and support operations or projected training requirements that would exceed current active range capabilities;

(2) Force structure: ranges held as inactive during realignment, reorganization, stationing, or reequipping of units projected to use these ranges under new training requirements; or

(3) Future: ranges that are held by DOD components for future use in support of National Security Policy or DOD component doctrine that ensures the capability to produce, establish, and maintain conditions needed for operational success.

Inhabited Building Distance (IBD): The minimum distance permitted between an inhabited building and an ammunition or explosives location for the protection of administration, quarters, industrial, and other similar areas within a naval shore establishment. Inhabited building distances shall be provided between ammunition or explosives locations and the boundary of a shore establishment of the nearest point beyond the boundary where such inhabited structures could be erected.

Integrated Training Area Management (ITAM): A U.S. Army program designed to improve range conditions by inventorying and monitoring land conditions, determining carrying capacity of the land in terms of the training requirements, and providing for land rehabilitation and maintenance measures.

Intentional detonation: An intentional detonation is a planned, controlled detonation.

Intrusive activity: An activity that involves or results in the penetration of the ground surface at an area known or suspected to contain MEC. Intrusive activities can be of an investigative or removal action nature.

IR: Installation Restoration.

ITAM: Integrated Training Area Management (a U.S. Army program).

JOCG: Joint Ordnance Commanders Group.

JUXOCO: Joint UXO Coordination Office.

MDAS: MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

MDEH: MPPEH that has been assessed and documented as to the explosive hazards the material is known or suspected to present and for which hthge chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

Material that Potentially Presenting an Explosive Hazard (MPPEH): Military munitions, including: their components; munitions packaging material; residues from research, development, testing, and evaluation (RDT&E), production, use (to include range scrap), operational and quality testing, or demilitarization of munitions; or any other materials, equipment, or facilities potentially contaminated with explosives. MPPEH includes both end items and residues derived from processing end-items within United Nations Organization (UNO) Hazard Class (HC). It also includes munitions-related items, pieces, models, training aids, etc., that are suspected but not confirmed to be wholly inert.

Maximum Credible Event (MCE): The worst single event that could occur at any time with maximum release of a chemical agent from a munition, container, or process as a result of an unintended, unplanned, or accidental occurrence.

MEC: munitions and explosives of concern. Distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded Ordnance (UXO), (B) Discarded military munitions (DMM), (C) Munitions Constituents (MC).

MIL SPECS/STDS: military specifications and standards.

Military Munitions (MM): All ammunition products and components produced or used by or for the DOD or the U.S. Armed Services for national defense and security, including military munitions under the control of the DOD, the U.S. Coast Guard, the U.S. DOE, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DOD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. It does not include: wholly inert items; improvised explosive devices; and nuclear weapons, devices, and components thereof. However, it does include nonnuclear components of nuclear devices, managed under DOE's nuclear weapons program after all required sanitation operations under the Atomic Energy Act of 1954, as amended, have been completed.

Military Range: A designated land or water area set aside, managed, and used to conduct research on, develop, test, and evaluate military munitions and explosives, or weapon systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas.

MLLW: mean lower low water.

Most Probable Event (MPE): The most likely event, as a result of an accidental, unplanned, or unintended detonation of an item of munitions, that could occur during MR activities. The event must be realistic, with reasonable probability of occurrence.

MPPEH: munitions that potentially presenting an explosive hazard.

MT: Mechanical time: fuzes designed usually for airburst. MT fuzes are located in the nose of the munition.

Munitions and Explosives of Concern (MEC): Military munitions that are UXO or have been abandoned, as defined in the EPA Munitions Rule. Also includes soil, facilities, equipment, or other materials contaminated with a high enough concentration of explosives that it presents an explosive hazard.

Munitions Constituents (MC): Any materials originating from military munitions, including explosive and/or non-explosive materials, and emission, degradation, or breakdown products. [The following additional explanation is offered for purposes of this SOP: Munitions constituents are the substances or chemical residues that result from the proper functioning or use of munitions (e.g., residues created and remaining in the soil, water, or air from the burning or explosion of energetic material) or that are present in MEC. Such constituents may or may not present an immediate risk of acute physical injury from fire or explosion resulting from accidental or unintentional detonation or ignition of MEC or energetic materials. Similarly, such constituents may or may not result in environmental contamination requiring a response (i.e., response action).]

Munitions Debris (MD): Metal fragments resulting from the intended use of munitions or detonations.

Munition with the Greatest Fragmentation Distance (MGFD). The munition with the greatest fragment distance that is reasonably expected (based on research or characterization) to be encountered in any particular munition response area (MRA) or munitions response site (MRS).

Munitions Response Area (MRA): Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites.

Munitions Response Site (MRS): A discrete location within a MRA that is known to require a munitions response.

Munitions Rule Implementation Policy: Detailed guidance and procedures issued by the Services that explains how DOD will implement and comply with the EPA Military Munitions Rule.

Munitions stockpile: Munitions in the active and demilitarization inventories as well as unused waste munitions as defined in the EPA's Military Munitions Rule (MMR). (See **active munitions inventory** and **demilitarization inventory**.)

Munitions: see **military munitions**.

Net Explosive Weight (NEW): The actual weight of explosive mixture or compound including the TNT equivalent of other energetic material which is used in the determination of explosive limits and ESQD arcs.

Non-stockpile Chemical Warfare Materiel: CWM (defined above) that is not included in the chemical stockpile. Non-stockpile CWM is divided into five categories: (1) buried CWM; (2) recovered chemical weapons (items recovered during range clearing operations, from chemical burial sites, and from research and development testing); (3) former chemical weapon production facilities; (4) binary chemical weapons; and (5) miscellaneous CWM (unfilled munitions and devices and equipment specially designed for use directly in connection with employment of chemical weapons).

OB: open burn.

OCR: Office(s) of Collateral Responsibility.

OD: open detonation.

ODEP: Office of Defense Environmental Programs.

ODUSD (I&E): Office of the Deputy Under Secretary of Defense (Installations and Environment).

OE Safety Specialist: a USACE employee involved in the execution, supervision, or oversight of munitions-related activities inside the exclusion zone who has graduated from the U.S. Naval EOD School, Indian Head, MD. An OE Safety Specialist shall be on-site each day during intrusive and MEC destruction activities. The OE Safety Specialist is on-site to ensure that the contractor establishes the appropriate daily safety routines at the beginning of UXO field operations, to perform quality assurance oversight, to verify contractor employee UXO qualifications, to advise the contractor on UXO procedures, to coordinate with the PM, and to facilitate EOD response when needed.

OEESCM: Operational and Environmental Executive Steering Committee for Munitions.

Open Burn (OB): A controlled open-air process by which excess, unserviceable, and obsolete munitions are destroyed to eliminate their inherent explosives safety hazards. DOD OB units contain the munitions with pans or pads to minimize environmental contamination. DOD OB units are permitted as "miscellaneous units" in EPA's environmental permitting process.

Open Detonation (OD): A process used for the treatment of unserviceable, obsolete, and/or waste munitions whereby an explosive donor charge initiates the munitions to be detonated. Although surface detonations can be performed under certain circumstances, most munitions are treated in 4- to 6-foot-deep pits for safety purposes. Most OD sites are permitted as miscellaneous units as part of the EPA environmental permitting process. DOD's units are generally permitted as combined OB/OD facilities.

Operational range: A military range that is currently under military control and management; includes both active ranges (currently in service or use) and inactive ranges (not in current use or service).

OPR: Office(s) of Primary Responsibility.

OSD: Office of the Secretary of Defense.

OU: Operable Unit.

OUSD (AT&L): Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics).

PD: point detonating: impact fuze, designed to function when the projectile comes in contact with the surface of a target; located in the nose of the munition.

Potential Explosion Site (PES): The location of a quantity of explosives that will create a blast, fragment, thermal, and/or debris hazard in event of an accidental explosion of its contents. Quantity limits for ammunition/explosives at a PES are determined by the distance to an exposed site.

POL: petroleum, oil, and lubricants.

PPE: personal protective equipment.

Primer: Small, sensitive explosive component used as the first element in the explosive train.

Proj: projo or projectile: A weapon that is projected through a tube or barrel into the air toward a target.

PSE: preliminary source evaluation.

PTT: powder train time fuse: Fuses designed usually for airburst, normally used with illumination rounds to light up the battlefield.

QA: quality assurance.

QC: quality control.

Quantity-Distance (Q-D): the quantity of explosives material and distance separations that provide defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q-D tables provided in DOD 6055.9-STD. Separation distances are not absolute safe distances but are relative protective safe distances. Greater distances than those shown in the Q-D tables shall be used whenever possible.

R&D: research and development.

RAB: Restoration Advisory Board.

RAC: Remedial Action Contract.

Range clearance: An operation or procedure conducted to remove and properly dispose of munitions or munitions fragments. (e.g., MEC, "duds," etc.). Several types or degrees of clearance may be conducted (e.g., surface clearance based on visual inspection of the surface; shallow clearance where an area is systematically swept with detectors—normally to a depth of 20-24 inches; etc.) Range clearance, though technically applicable to any range category (closed, transferred, active, etc.) is often considered as occurring only at active, operational ranges. Clearance operations at these active ranges are normally conducted as part of range maintenance activities to maintain or enhance operational safety conditions at the range facility. Even though it is possible for MEC to cause environmental contamination (pollution of soil, surface water, groundwater, etc., from the chemical constituents present in munitions), range clearance is focused on removing and safely disposing of munitions items or fragments—not the removal or treatment of any chemical residues or constituents from the munitions or associated environmental contamination. Cleanup of environmental contamination or pollution is normally achieved by removal or remedial actions.

Range: see **military range**.

RCRA: Resource Conservation and Recovery Act.

RCWM: recovered chemical warfare material.

RDT&E: research, development, test, and evaluation.

Regional Environmental Coordinator (REC): A senior military officer or DOD civilian assigned to one of ten EPA regions who is responsible for the dissemination of information and coordination of environmental matters and public affairs among military installations and environmental regulatory organizations within their respective region. RECs have a liaison role and fully adhere to the Services' chain of command.

Remedial Action/RRemoval Action process: Longer-term activities that complete the cleanup of contamination (or a contaminated site or location) if a removal action has not achieved or cannot achieve the required degree of cleanup for the contamination problem. A distinction is sometimes made between the control or cleanup measures to be implemented, which are called "remedial actions," and the identification, evaluation, decision-making, and design and construction steps required to implement the control measures. These steps collectively are called the "remedial action process."

Removal Action(s): Relatively quick actions designed to address imminent threats to human health and the environment posed by releases or spills of hazardous substances. Removals should satisfy one or more of the following tests:

(1) **Imminent threat:** the site or situation poses an imminent threat to public health.

(2) **Source control:** the removal action either removes the source of contamination off-site or effectively contains it on-site so that continuing releases to the environment are prevented or reduced.

(3) **Access limitation:** the removal action substantially reduces the possibility of human exposure to hazardous substances. The EPA has categorized removal actions as emergency, time-critical, and non-time-critical. Each of these categories possesses its own criteria and procedural requirements.

Resource recovery and recycling (R3): Technologies and processes used by DOD to demilitarize military munitions. These include reuse, sale "as is" (e.g., Foreign Military Sales), conversion to a commercial product for sale or industrial use, or disassembly, modification, and partial or whole use for a military application.

Response(s) or Response Action(s): Responses or response actions are broadly defined in environmental law and regulations as any scientific or engineering investigation, evaluation, decision-making, design, or implementation step taken in response to (i.e., to clean up) a release or spill of hazardous substances. Removals and remedial actions (or remedial action processes) are subcategories of response actions. Procedural requirements (established in environmental regulations) for these two types of actions differ substantially, but their definitions are almost as broad as for "responses," allowing the terms to be used almost interchangeably. The various terms are best defined by the procedural requirements imposed on them by the applicable environmental regulations.

RI/FS: remedial investigation/feasibility study.

ROD: Record of Decision.

Senior UXO Supervisor (SUXOS): Supervises all contractor on-site UXO activities. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. Must have at least 10 years of combined active-duty military EOD and contractor UXO experience, to include at least 5 years in supervisory positions.

SERDP: Strategic Environmental Research and Development Program.

SHPO: State Historic Preservation Officer.

Single Manager for Conventional Ammunition (SMCA): A DOD executive agent responsibility performed by the U.S. Army Operations Support Command. The Secretary of the Army is DOD's SMCA. The U.S. Army OSC is the day-to-day operator of the SMCA and serves as the central program manager for the execution of most of DOD's demilitarization requirements. The objectives and responsibilities of the SMCA can be found in DOD Directive 5160.65.

Sustainable Range Management: Management of a military range in a manner that supports national security objectives and maintains the operational readiness of the Armed Forces and ensures the long-term viability of the range while protecting human health and the environment. [The following additional explanation is offered for purposes of this SOP:

A comprehensive DOD approach that develops and implements the policies, plans, practices, and procedures necessary to achieve sustainable ranges. Sustainable ranges are managed and operated in a manner that supports their long-term viability and utility to meet the national defense mission. Sustainable ranges will implement the planning, management, coordination, and public outreach necessary to ensure viable continuity of test and training operations and long-term coexistence with neighboring communities and natural ecosystems.]

Sustainable use: Actions taken to ensure that ranges maintain the ability to conduct training, research, development, testing, and evaluation of munitions in support of the national defense mission while minimizing adverse effects to human health and the environment.

SUXOS: Senior UXO Supervisor.

SWMU: solid waste management unit.

TNT equivalent: Considering the peak overpressure produced by detonation of a given weight of TNT as 100 percent, the TNT equivalency of an explosive is the amount of overpressure produced by detonation of an identical quantity of propellant under comparable conditions, expressed as a percentage.

Transferred range: A military range that is no longer under the control of a DOD component and has been leased, transferred, or returned to another entity (including other federal, non-DOD entities) for use.

Transferring range: A military range that is proposed to be leased or transferred from DOD to another entity or disposed of by conveying title to a non-federal entity. An active range will not be considered a "transferring range" until the transfer is imminent.

TRI: Toxic Release Inventory (required by the EPCRA).

Unexploded ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for use and that have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or materiel and that remain unexploded by malfunction, design, or any other cause. UXO presents an immediate risk of acute physical injury from fire or explosion resulting from accidental or unintentional detonation.

Unintentional detonation: A detonation not planned in advance.

USACE: U.S. Army Corps of Engineers.

Used or fired military munitions: Those military munitions that meet the following criteria: (1) have been primed, fuzed, armed, or otherwise prepared for use, and have been fired, dropped, launched, projected, placed, or otherwise used; (2) munitions fragments, (e.g., shrapnel, casings, fins, and other components, to include arming wires and pins) that result from the use of military munitions; or (3) malfunctions or misfires (e.g., fail to properly fire or detonate).

USFWS: U.S. Fish and Wildlife Service.

USGS: U.S. Geological Survey.

UST: underground storage tank.

UTM: Universal Transverse Mercator.

UXO: unexploded ordnance.

UXO personnel: Contractor personnel who have completed specialized military training in EOD methods and have satisfactorily performed the EOD function while serving in the military. Various grades and contract positions are established based on skills and experience.

UXO Quality Control Specialist (UXOQCS): Contractor personnel with the responsibility of enforcing the contractor's Quality Control Program for all MR-related evolutions; conducting quality control inspections of all UXO and explosives operations for compliance with established procedures; and directing and approving all corrective actions to ensure that all MR-related work complies with contractual requirements.

UXO Safety Officer (UXOSO): Contractor personnel with the responsibility of enforcing the contractor's SSHP. This individual must, therefore, be in the field whenever possible to observe operations. Must have the same minimum qualifications as the UXO Technician III. In addition, must have the specific training, knowledge, and experience necessary to implement the SSHP and verify compliance with applicable safety and health requirements.

UXO Technician II: must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; the U.S. Naval EOD School, Indian Head, MD; U.S. Naval EOD School, Eglin AFB, FL; or a DOD-equivalent certified course. Must have a minimum of five years of military EOD or contractor UXO experience.

UXO Technician III: supervises a UXO team. Must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; the U.S. Naval EOD School, Indian Head, MD; U.S. Naval EOD School, Eglin AFB, FL; or a DOD-equivalent certified course. This individual must have a minimum of ten years of military EOD or contractor UXO experience.

UXO: unexploded ordnance.

UXOQCS: UXO Quality Control Specialist.

UXOSO: UXO Safety Officer.

Waste Military Munitions: A military munition that is a solid waste per 40 CFR §266.202. Such a waste military munition may also be a hazardous waste if it meets the definition found in 40 CFR §261.3. Waste munitions are hazardous wastes when they exhibit the hazardous waste characteristic of ignitability, corrosivity, reactivity, or toxicity, or are listed as hazardous wastes.

WP: white phosphorus: A screening smoke that burns on contact with air and can be used as an incendiary.

CH2MHILL

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

Attachment 4: Explosives Management Check List

Date	Check List Item	PM Date Completed	MR Ops Review Date	MR QC NTP Date
	Contract Terms and Conditions			N/A
	Scope of Work			N/A
	Completed: Opportunity Risk Evaluation (ORE), Paragraph 17 MR Projects and CDC Projects			
	Explosive Management Plan (*)			
	Explosive Siting Plan (*)			
	Obtain State/local (if required) Explosive Permit* for CH2M HILL to use high explosives within the state and or local jurisdiction.			
	Obtain State/local (if required) Permit* for CH2M HILL to site explosives magazine within the state and or local jurisdiction.			
	Identify CH2M HILL HILL HILL licensed Blaster* (if self-performing)			
	CH2M HILL ATF&E “Request to Order Explosives” form for Review and obtain authorization signature of ATF Permittee			
	Original signature of ATF&E Type 20 Explosives Manufacture License* from CH2M HILL License Holder			
	“Authorization Letter*” identifying “Responsible Persons” and “Possessor of Explosives” that are authorized to order, receive, store, and use explosives under the CH2M HILL ATF&E Type 20 Explosives Manufacturer License			
	Vender Identified by contracting (If sole source - justification is required)			N/A
	Vender required to provide a copy of their ATF&E License* to CH2M HILL ATF&E files			
STOP!!! MANDATORY MUNITIONS RESPONSE QC CHECK				
	Purchase Order* provided to vender with a copy of ATF&E Type 20 Manufacturer of High Explosives License, with endorsement			

Date	Check List Item	PM Date Completed	MR Ops Review Date	MR QC NTP Date
	Purchase Order* provided to vender with Authorization Letter for Responsible Persons and Employee Possessor of Explosives			
	Award the purchase order to the selected vender - - Hold authorization for Vendor to ship explosives			
	Notify Vendor of CH2M Possessor of Explosives authorized to receive explosives at the project site, telephone number and address of receiving location			
	Vender accepts purchase order and holds for contracting release of explosives shipment			
	Vender identifies carrier and provides a shipment schedule with copy of manifest* to CH2M HILL contracting and contracting notifies the Project Manager			
	Establish Explosives Storage Area (Security, Lightening Protection, Grounding)			
	Schedule State and or local jurisdiction site inspection for “Explosive Storage” (Magazines) if required.			
	Magazine storage area inspected and approved* for storage by local jurisdictions (if required).			
	CH2M HILL contracting notifies vender to release explosives shipment			
	Notify ATF&E servicing office for CH2M HILL ATF&E License*, local ATF&E office*, and local jurisdictions* of storage of explosives and provide an Explosives Siting Plan that includes ATF Form 5400.13/5400.16, Explosives Storage Magazine Description Worksheet* (as required).			
	Post CH2M HILL ATF&E Type 20 License on the project site			
	CH2M HILL “Responsible Person” or Possessor of Explosives” person receives shipment (presents identification to transporter, verifies manifest, and inventories shipment to ensure accuracy between purchase order and manifest. Discrepancies should be resolved IAW the project Explosive Management Plan)			
	Explosive materials are properly inventoried (date shift codes, acquisition dealer, license address, POC), and stored IAW project Explosives Management Plan			
	Material Safety Data Sheets (MSDS) for explosives materials are on-site			

Date	Check List Item	PM Date Completed	MR Ops Review Date	MR QC NTP Date
	Magazine Data Cards (Daily Summary of Magazine Transactions*) are completed and maintained IAW project Explosives Management Plan			
	Magazine has two mortise type 5 (or equivalent) pin high security locks			
	Security Checks conducted a minimum of every 72 hours and documented or IAW work plan approved methods*			
	Responsible person or possessor of explosives has control of keys to magazines (IAW local procedures).			
	Daily Usage (Shot) Log* maintained for expenditure of explosive materials including target materials			
	Weekly inventories of all explosives materials conducted and documented*			
	PM to notify local jurisdictions and ATF&E offices when explosives materials are no longer being stored*			
	*Project Manager to provide to the ATF&E License Holder completed purchase orders, manifest documents, inventories, magazine data cards, usage logs, and any other associated information for ordering, storage and use of explosives material along with an end user certification that all explosives materials have been accounted for.			
	MR Safety Officer shall conduct a quality control audit of the project explosives management plan with ATF&E requirements and report on the conformance of the Project Manager & License Holder.			
	* Indicates documents that upon completion of project will be forwarded to the License Holder and copy to Safety Office			

REQUEST to ORDER EXPLOSIVES		
Instructions: Enter information for the procurement of one (1) Explosive Class/Product Trade Name per request form.		
Block 1.	Block 2.	Block 3.
Project Name	Project Number	Date of Request mm/dd/yyyy
Block 4.	Block 5.	Block 6.
Project Manager (First, Middle, Last)	Office Location/Symbol	Project Manager Telephone Number
Block 7.	Block 8.	Block 9.
Delivery Date mm/dd/yyyy	Delivery Address	Delivery Telephone Number
Street		Block 10.
City		Receiving Person (First, Middle, Last)
County/province		
State		Block 11.
Postal Code		Receiving Person Telephone Number
Country		
Block 12.	Block 13.	Block 14.
Vendor/Supplier/Organization	Vendor ATF License	Vendor ATF License
Block 15.	Block 16.	Block 17.
Vendor/Supplier/Organization		Vendor Telephone Number
Street		
City		Block 18.
County/province		Vendor Point of Contact Person
State		
Postal Code		Primary Tel. #:
Country		2nd Tel.#:
Block 19.	Block 20.	Block 21.
Product Trade Name	Product Unit of Issue (EA, LB, FT, RL,BX)	Product Quantity Requested (Number)
Block 22.	Block 23.	Block 24.
Vendor Lot Number	Vendor Date Shift Code	Vendor MSDS Product Name
Block 25.	Block 26.	Block 27.
DOT EX Number	UN Number	DOT Hazard Class/Division
Block 28.	Block 29.	Block 30.
Estimated Product Cost	Estimated Shipping Cost	Estimated Total Cost
AUTHORIZATION FOR PURCHASING TO ORDER EXPLOSIVES		
ATF Licensee Signature		
Date		

SOP UXO Contacts

Name	Title	Office
Ben Redmond	MR Market Segment Director	KNV
George DeMetropolis	MR Western Region MR Market Segment Manager	SDO
Brint Bixler	MR Northeastern Region MR Market Segment Manager	WDC
Kyra Donell/KNV	MR Southeastern Region MR Market Segment Manager	KNV
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Kevin Lombardo	MR Operations Manager	WDC
George DeMetropolis	Coporate MR Safety QC Officier	SDO
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STANDARD OPERATING PROCEDURE

Direct-Push Soil Sample Collection

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer
- Sampling rods
- Sampling tubes and acetate liners
- Pre-cleaned sample containers and stainless-steel sampling implements
- Personal Protective Equipment as specified by the Health and Safety Plan

IV. Procedures and Guidelines

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

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

3. Remove the rods and sampling tube from the borehole and remove the sampling tube from the lead rod.

4. Cut open the acetate liner using a specific knife designed to slice the acetate liners (see below).

5. Fill all sample containers, beginning with the containers for VOC analysis, using a decontaminated or dedicated sampling implement. For the VOC samples, place the sample into a pre-preserved VOA vial or direct sample container such as an **En Core**® sampler and seal the cap tightly. Ideally, the operation should be completed in one minute. Label the vials and place on ice for shipment to the laboratory.

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

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

V. Key Checks and Items

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

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

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

Attachment 2
Data Management Guidelines

Version 1

Navy CLEAN Data Management Plan

Prepared for

Navy CLEAN & Joint Venture Programs

June 2011

CH2MHILL

Preface

This document presents the standardized six-step workflow process for environmental data management being performed for the Navy Comprehensive Long-Term Environmental Action - Navy (CLEAN) and Joint Venture Programs. Included in Appendix A is the responsible, approve, support, consult, and inform (RASCI) diagram along with the associated roles and responsibilities, which is the basis for the Navy CLEAN and Joint Venture Programs Data Management Plan (DMP). Following are the six steps in the workflow process:

1. Project planning and database setup
2. Sample collection and management
3. Laboratory analysis
4. Data validation and loading
5. Data management
6. Data evaluation and reporting

Figure P-1 presents a simplified presentation of the workflow process specific to the Navy CLEAN and Joint Venture Programs. The various steps in the flow process are numbered 1 to 26. Figure P-2 presents, in more detail, the tools used in each step of the process.

Appendix B contains a data flow diagram that outlines the tools that used to help collect data for all program and project activities. CH2M HILL uses the Sample Tracking Program (STSP) to initiate the sample collection, documentation, and tracking processes. During the laboratory analysis and data validation phase, the CH-Analyzer and Validation Data Management System (VDMS) software will be used to help evaluate the quality of the data. At the data management step, the CH-ERPTool will be used to format the data and the CH-IMPTool will be used to transfer the data into the Navy CLEAN data warehouse. At the data evaluation stage, the XTabReports Tool will be used to query data from the data warehouse, and the Crosstab Cleanup Tool and RDE Formatting Tool will produce and format data tables and comparisons to project action levels. The Site Information Management System Visual Interface to the data warehouse is an application that is often used to access and query data. Appropriate section(s) of the DMP include additional details on each of the tools used.

Change Management

This DMP is a "living" document and content may be revised or amended to accommodate changes in the scope of environmental investigations or data management requirements that affect the entire Navy CLEAN Program. In addition, the DMP appendices will be subject to modification as new or improved methods of data management are developed and implemented.

Any modifications made to the tools will be communicated to the project team via e-mail. As revisions are finalized, they will be distributed electronically to all users. After revision, it is the user's responsibility to conform to revised portions of the DMP.

Amendments will be versioned and released according to the following naming scheme: [Document Name_v#.#_yymmdd]. If a significant change is made to any of these files, the version number will increase by one integer. The revision history is shown in the following table.

REVISION HISTORY
Navy CLEAN and Joint Venture Programs Data Management Plan

Revision Date	Initiator	Purpose

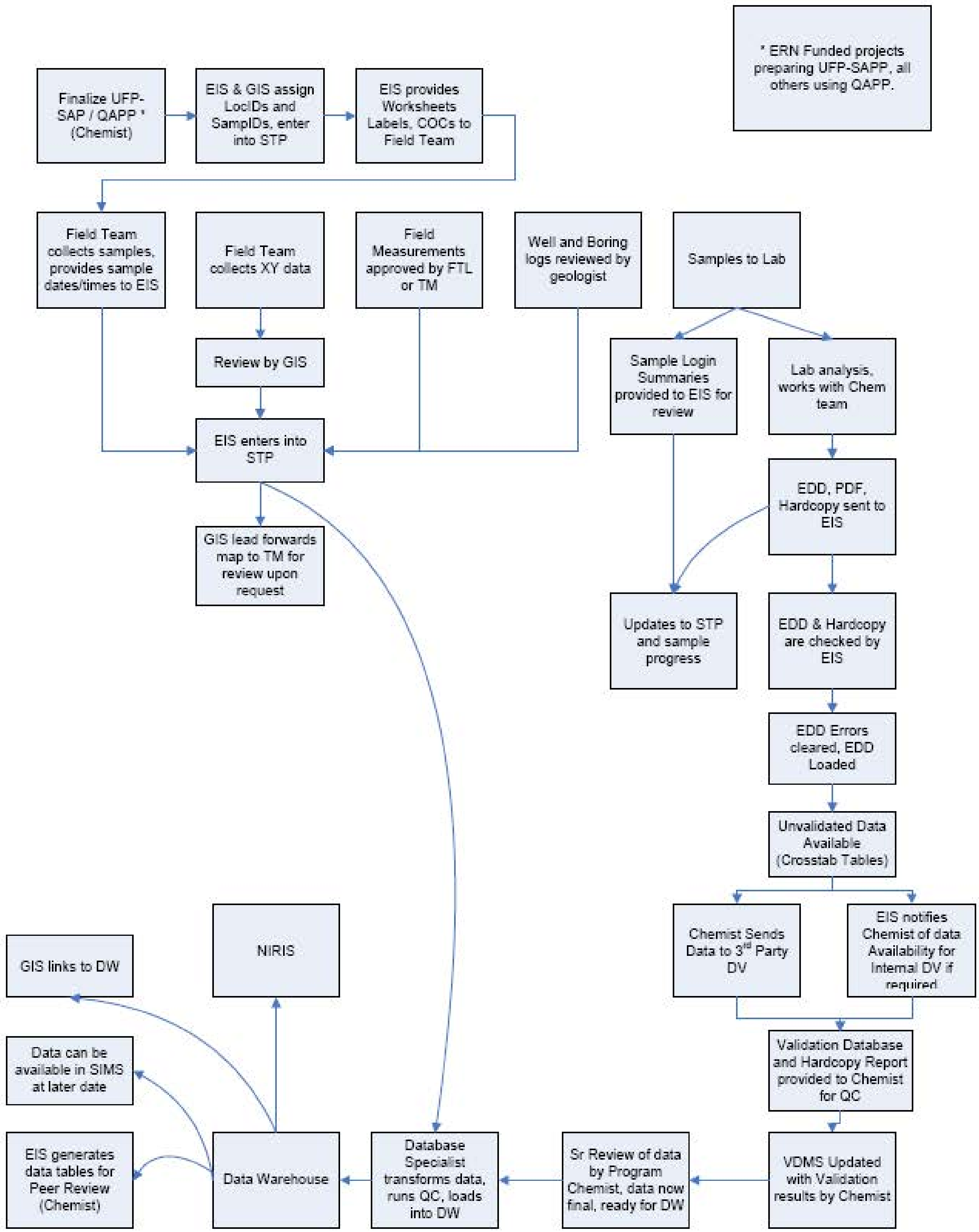

FIGURE P-1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

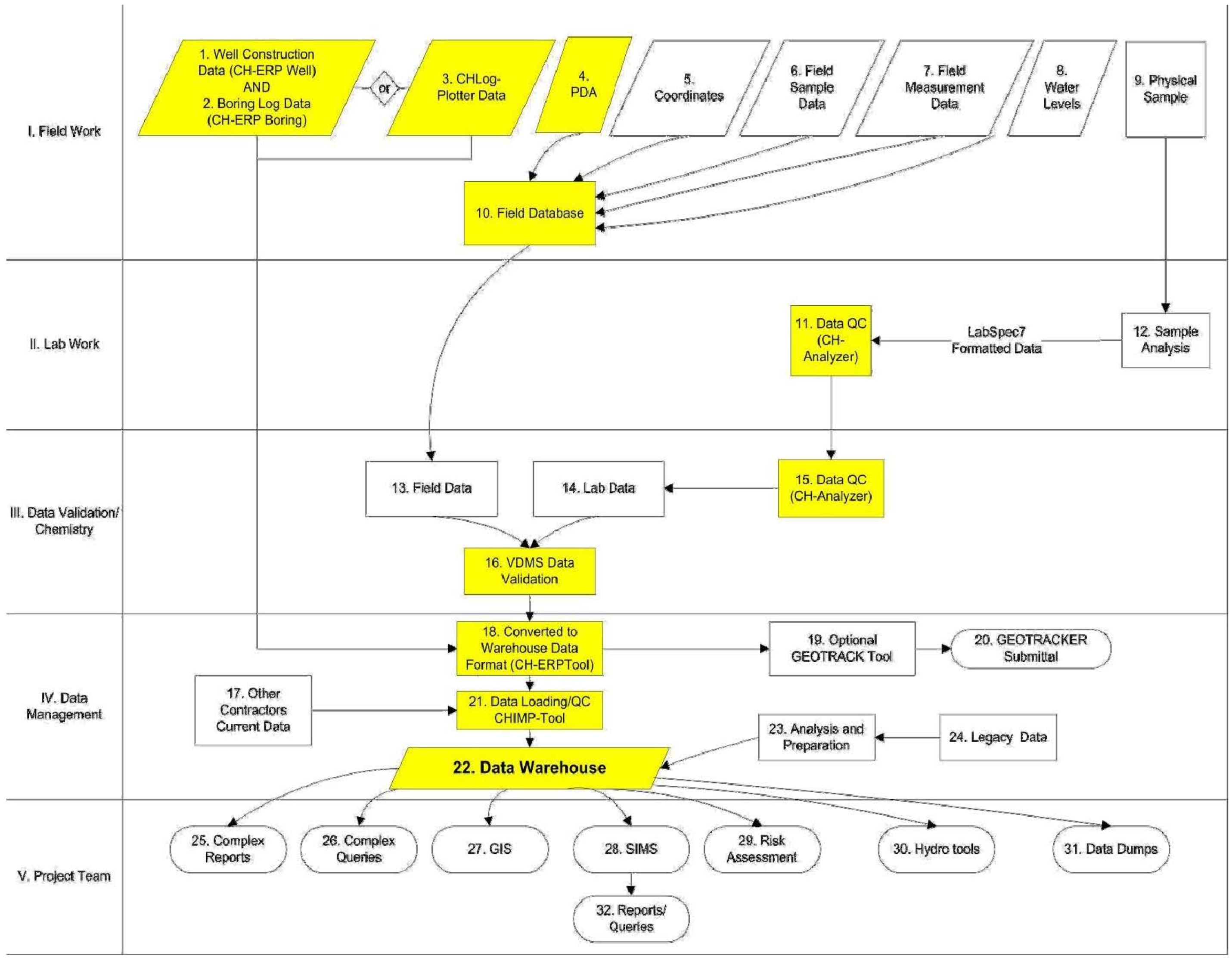

FIGURE P-2
DBMS PROCESS

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Acronyms and Abbreviations

AFCEE	Air Force Center for Engineering and the Environment
AM	Activity Manager
CAD	computer-aided design
COC	chain-of-custody
DBMS	Database Management System
DBS	Database Specialist
DMP	Data Management Plan
EDD	electronic data deliverable
EDM	Environmental Data Management
EIS	Environmental Information Specialist
EMS	Enterprise Management Solutions
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
EVS	Environmental Visualization System
FD	field duplicate
FTL	Field Team Leader
GA	GIS Analyst
GIS	geographic information system
ID	identification
IDW	investigation-derived waste
IRP	Installation Restoration Program
MS	matrix spike
MSD	matrix spike duplicate
N/FD	normal/field duplicate
NAVFAC	Naval Facilities Engineering Command
NEDD	Naval Installation Restoration Information Solution Electronic Data Deliverable

NIRIS	Naval Installation Restoration Information Solution
ODBC	open database connectivity
PC	Project Chemist
PCL	Program Chemistry Lead
PDL	Program Data Management Lead
PGDB	personal geodatabase
PGL	Program GIS Lead
PM	Project Manager
QA	quality assurance
QC	quality control
RASCI	responsible, approve, support, consult, and inform
RDM	Regional Database Manager
SDG	Sample Delivery Group
SIMS	Site Information Management System
SOP	standard operating procedure
STSP	Sample Tracking Program
VDMS	Validated Data Management System

SECTION 1

Introduction

This Data Management Plan (DMP) describes the methods CH2M HILL will use to manage and present environmental data to support work it is conducting for the Navy CLEAN and Joint Venture Programs. These processes and procedures are part of an overall environmental data management system called the Validation Data Management System (VDMS) hosted by CH2M HILL.

Project members and any subcontractors supporting program data needs for site characterization and remediation activities can use this DMP. It is a living document that is flexible enough to meet the dynamic needs of the teams and stakeholders. Data management program details and procedures are included in the appendices.

1.1 Purpose and Objective

This document outlines how environmental data for the Navy CLEAN and Joint Venture Programs will be obtained and managed using an Enterprise Management Solutions (EMS) approach. The systematic approach will facilitate the retrieval of data from project files and the data warehouse when they are needed, help ensure that the required data are collected and are of the appropriate quality, and help ensure that data records are not lost during transfer to the central program database repository.

The EMS objectives critical to the success of the DMP are as follows:

- **Standardize and facilitate data collection.** Use standard field forms and database applications; provide guidance and standard operating procedures (SOPs) for formatting, reviewing, and transferring data collected in the field to the Database Management System (DBMS).
- **Provide the ability to capture electronic field data directly or indirectly.** Items that will be captured through standardized forms or applications include chains-of-custody (COCs), field parameter information, groundwater elevation data, and sample tracking records.
- **Minimize the uncertainties associated with the data.** Implement quality assurance (QA) and quality control (QC) measures to provide accurate representation of all data collected and stored in the DBMS. QA/QC procedures include restricting data import or entry to specific valid value lists that will not allow incorrect data to be included in the DBMS.
- **Provide a structured, yet flexible data set.** The DBMS will store all types of environmental data and provides a standard framework for all projects within the Navy CLEAN Program to use. The DBMS is organized and structured, yet flexible enough to allow additional data and data types to be added at any time over the life of the program.
- **Provide data that are well documented.** Retain enough descriptive and source information for technical defensibility and legal admissibility of the data.

- **Provide end-users with tools to gain access to the data.** Provide reporting and delivery support from a single DBMS source and allow relatively simple and rapid access to stored data for environmental characterization, report generation, modeling, geographic information system (GIS) mapping, statistical analyses, and risk assessments.
- **Provide data visualization capabilities.** Allow accurate representation of data used in models, GIS, boring log programs (Environmental Visualization System [EVS), computer-aided design (CAD), graphics, and other software used for mapping, graphing, charting, analyzing, and displaying environmental data.
- **Provide the ability to compare data electronically.** Allow electronic comparison of project data to specific reference or screening criteria.
- **Provide the ability to transfer data to different formats.** Provide the ability to reformat, convert, and transfer the data to any format as required by specific end-user applications.

1.2 Scope of the Data Management Plan

The scope of the data management activities addressed by this plan includes the following:

- Definition of staff roles and responsibilities (Appendix A).
- Flow diagrams illustrating how environmental data are collected, reviewed, and entered into the DBMS (Appendix B)
- SOPs (Appendix C).
- Description and use of data outputs (Appendix D).
- Electronic data deliverable (EDD) format specifications that analytical laboratories are required to use to transfer analytical data electronically to CH2M HILL. (Provided to laboratories via a scope of work.)
- Management and archive procedures for hard copy and electronic project documentation.

SECTION 2

Roles and Responsibilities

The Navy CLEAN and Joint Venture Programs Environmental Data Management (EDM) team will work together to properly execute the DMP and ensure that the project objectives and scope are realized. The EDM team is composed of environmental, data, GIS, and EMS resources. The EDM team is responsible for all aspects of planning, execution, and reporting environmental data. Data are derived from sampling events related to investigative and remedial activities for Navy CLEAN and Joint Venture projects.

Responsibilities related to data management and information solutions functions are grouped into roles, as listed in Table 1. Checklist_VDMS-DM-Process_20090615 in Appendix C documents the specific responsibilities associated with each of these roles.

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Navy CLEAN Activity Manager (AM)	Various	Various	Various	Various
Navy CLEAN Project Manager (PM)	Various	Various	Various	Various
Field Team Leader (FTL)	Various	Various	Various	Various
Program EMS Team Lead	John Kochanowski 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6227	757-497-6885	jkochanowski@ch2m.com
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Project Chemist (PC)	Megan Hilton 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	401-619-2657	703-376-5801	mhilton@ch2m.com
Project Chemist (PC) / Environmental Information Specialist (EIS)	Bianca Kleist 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6281	757-497-6885	bkleist@ch2m.com
Database Specialist (DBS)	Bhavana Reddy 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703- 462-3784	703- 376-5010	breddy@ch2m.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
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Environmental Information Specialist (EIS)	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
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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.

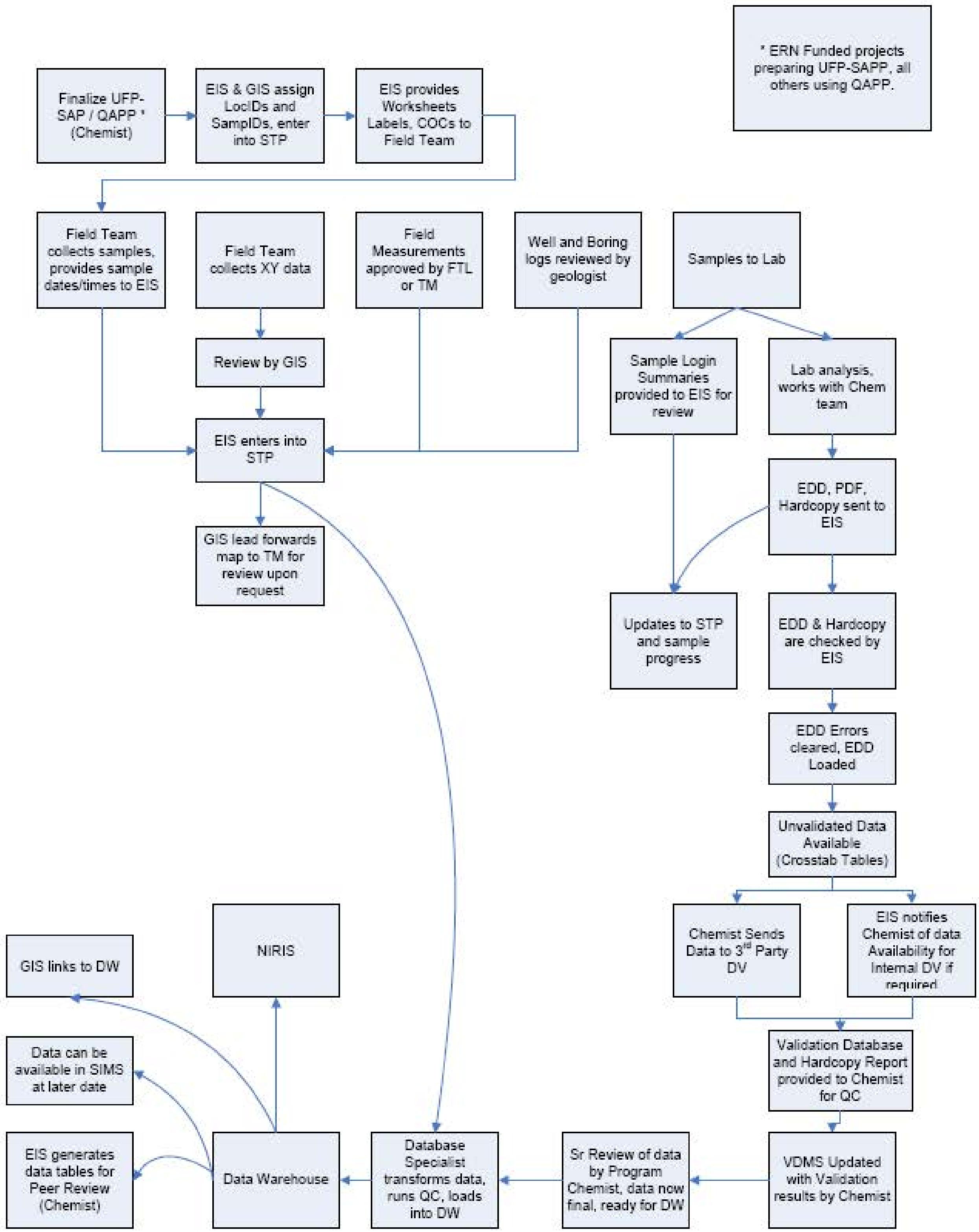


FIGURE 1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

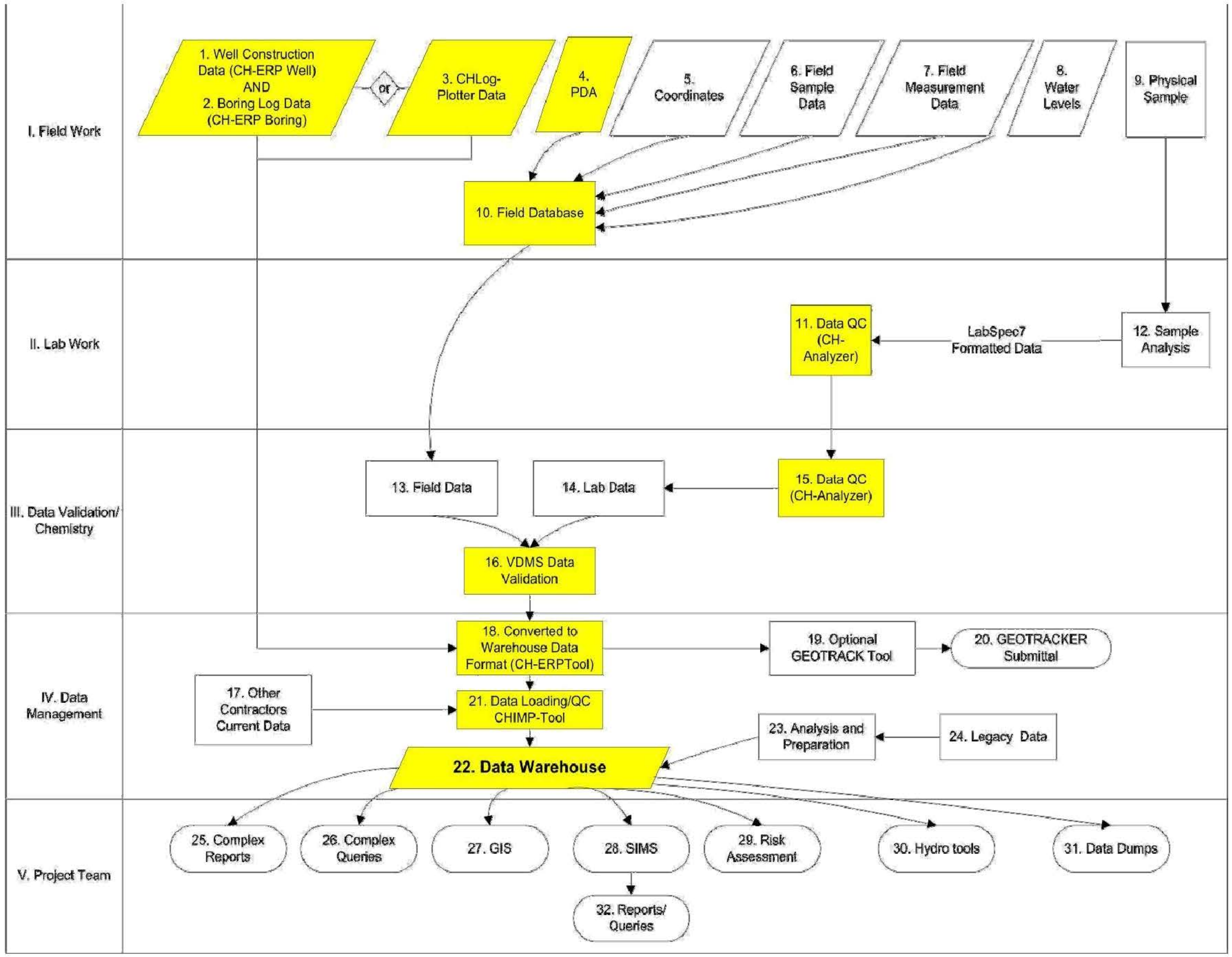


FIGURE 2
DBMS PROCESS

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.

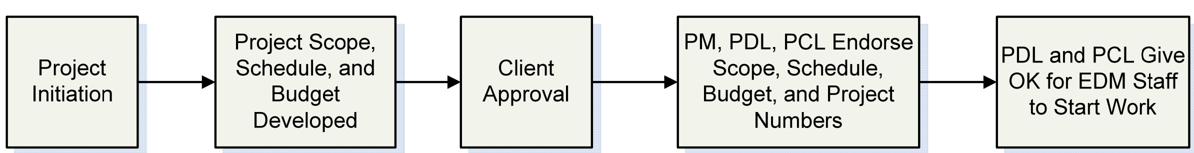


FIGURE 3
PROJECT PLANNING

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.

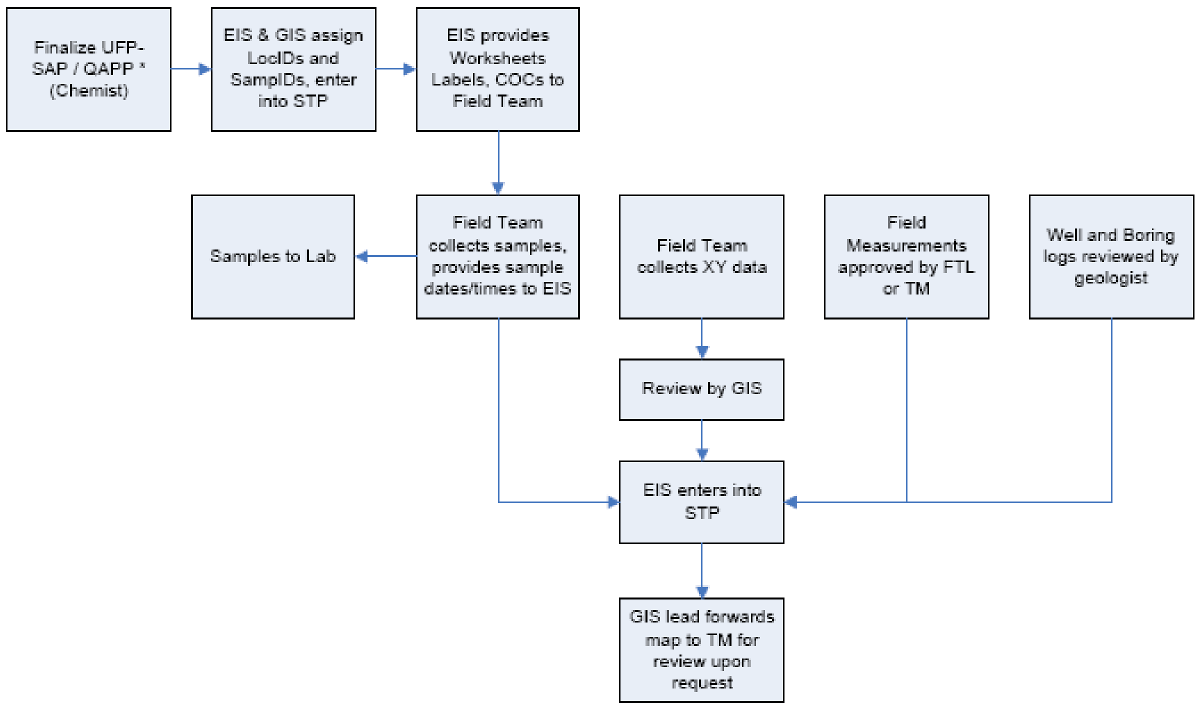


FIGURE 4
FIELD SAMPLING

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	AANNNA	A	NNNNA

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

<u>Site/AOC/SWMU – Sequential Number:</u>

Site = S01, S02, S03…
Site Screening Area = SA01, SA02, SA03…
AOC = A01, A02, A03…
AOI = AI01, AI02, AI03…
SWMU = W01, W02…
Building = B01, B02, B03…
Range = R01, R02…
LIA – LI Area, East Vieques

BSxx = Background locations outside of site (BS25 = Background Site 25)
BKL = Background locations outside of the facility
BKG Background locations (inside base)

<u>Sample Type:</u>

AGT = Above Ground Tank
AH = Air - Headspace
AS = Ash
BH = Borehole
CO = Concrete
DR = Drill Rig
DS = Direct Push—Soil
DW = Direct Push—Groundwater
EW = Extraction Well
FG = Frog
FS = Fish
GB = Geotechnical Boring
GP = Geoprobe
GV = Gas Vent
HP = Holding Pond/Lagoon
IW = Injection Well
LF = Free Product
LW = Leach Well
MA = Alluvial Monitoring Well
MB = Bedrock Monitoring Well
MU = UST Monitoring Well
MW = Monitoring Well (GW for Y)
PC = Paint Chip
PW = Production Well
RK = Rock
SW = Surface Water
RC = Recovery Well
RM = Remediation Well
RW = Residential Well
SB = Subsurface Soil
SD = Sediment Location
SG = Soil Gas
SL = Storm Sewer Line Sediment
SO = Soil Location (Composite)
SP = Seep
SS = Surface Soil
SSD = Subsurface Sediment
ST = Storm Water
SU = Sump
SV = Soil Vapor
SW = Surface Water
UST = Underground Storage Tank
TA = Tap Water
TD = Tidal Station
TI = Tissue Sample (general)
TO = Tadpole
TP = Test Pit
TR = Trench Sediment
TS = Treatment System
TW = Temporary Well
WA = Alluvial Extraction Well
WB = Bedrock Extraction Well
WL = Water Supply Well
WN = Pore Water
WP = Wipe Sample
WT = Water Table Piezometer

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

<u>Modifier (used selectively):</u>
D = Deep monitoring well
S = Shallow monitoring well
P = Duplicate

<u>Depth</u>:

Use only if applicable. A sequential letter is used to reflect varying depths, as actual depths can change in the field after sample planning has occurred. E.g. A, B, C…

<u>Sample Number:</u>

1. Duplicate Samples - Use a 'P' modifier in the second segment of the sample ID, directly after the location number to indicate a duplicate sample. E.g. AB01-MW11P-0506

2. MS/MSD Samples – Append a modifier of '-MS' for matrix spike or '-SD' for matrix spike duplicate to the end of the sample ID.

3. QC & IDW Samples (Blank Samples & Waste Char.) - Format consists of Facility, AOC Number, Qualifier Code, Sequential Qualifier Number-Date (AAANN-AANN-MMDDYY). E.g. LSA05-TB02-061106

<u>Qualifier Codes</u>:
TB = Trip Blank
FB = Field Blank
EB = Equipment Blank
WQ = Source Blank
WS = Waste Char. Soil
WW = Waste Char. Water

4. Drill Rig Samples – Format consists of Facility, AOC Number, Station Type, Station Number, Date. E.g. YS12-DR02-020507

5. Multiple samples - Should multiple samples be collected from the same location in a given day/month (affects only samples not differentiated by depth), a sequential letter will be added to the end of the fourth segment (date). E.g. A, B, C…

<u>Example Sample IDs:</u>

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

TABLE 3
STATION ID SCHEME

4.2.3 Sample Collection

A photocopy of each field logbook page completed during sampling and of each COC will be made by the FTL and forwarded to the EIS at predefined intervals during sampling events. This information will serve as notification to the EIS of samples being shipped to an offsite lab and of the field crew's sampling progress.

Communication with field and laboratory staff will occur daily during the field event. The EIS will resolve issues that arise in the field (bottle ware shortage, equipment failure, etc). The lab will be informed of the shipment dates and the number of coolers or samples being sent. Laboratory login reports will be reviewed to ensure samples were received in good condition (no breakage, within holding time, within designated temperature). The field crew and PM will be notified if there were problems with shipment.

4.2.4 Chain-of-Custody and eData

A single COC number per project / laboratory / cooler should be generated each day (there can be multiple pages to one COC number). MSs and MSDs will be requested at a set frequency for each project (usually one per 20 samples collected). MS and MSD samples should not be taken from field duplicates (FDs) or field blanks. FDs will be requested at a set frequency for each project (usually one per 10 samples). FDs should not be taken from MSs, MSDs, or field blanks. The MS and MSD samples listed on the COC should be spiked and analyzed by the laboratory.

A 100% QC will be performed on COCs received from the field crew. The field crew and/or lab will be notified if corrections need to be made the COCs or lab login reports. Any corrections or modifications made will be noted in a Corrections-To-File Letter.

Once the field data and samples are collected, information on sampling date and time are to be entered into the STSP by the EIS, and as necessary field measurements, such as water levels and other data collected in the field also should be entered. Any data entered into the STSP must be exported into an excel file to facilitate a manual QC review of the data. The correction of any anomalies should be verified with the PM and PC. The information entered into the STSP will be exported into CH2M HILL's VDMS where field data and laboratory analytical data are linked by location and sample ID. This allows verification that all sample and method combinations have been received and reported by the laboratory.

4.2.5 Sample and Document Tracking

A Sample Tracking Sheet (STS) will be generated from the sample information entered and QC'd in the STSP. The STS should be updated and kept current throughout the data management process. All samples collected, resulting deliverables, and deliverable dates will be tracked throughout the data management process to ensure that the project schedule is met and subcontractor invoices are evaluated correctly.

All documentation acquired during the data management process, including Statements of Work (SOWs), Bids, COCs, Field Notes, Sample Tracking Sheets, Login Reports, Corrections-to-File Letters, FDETool QC tables, Post Load Reports, Invoices, and Communication Logs shall be compiled throughout the process to be stored in the appropriate Activity's Project Notebook.

4.3 Laboratory Analysis

Figure 5 shows the laboratory analysis process. Upon receipt of samples from the field, the laboratory will check that the COC forms correctly cover all samples submitted. Each COC form must be signed with the date and time of receipt by the laboratory. Samples will be logged in by the laboratory using information from the COC forms and the project instructions.

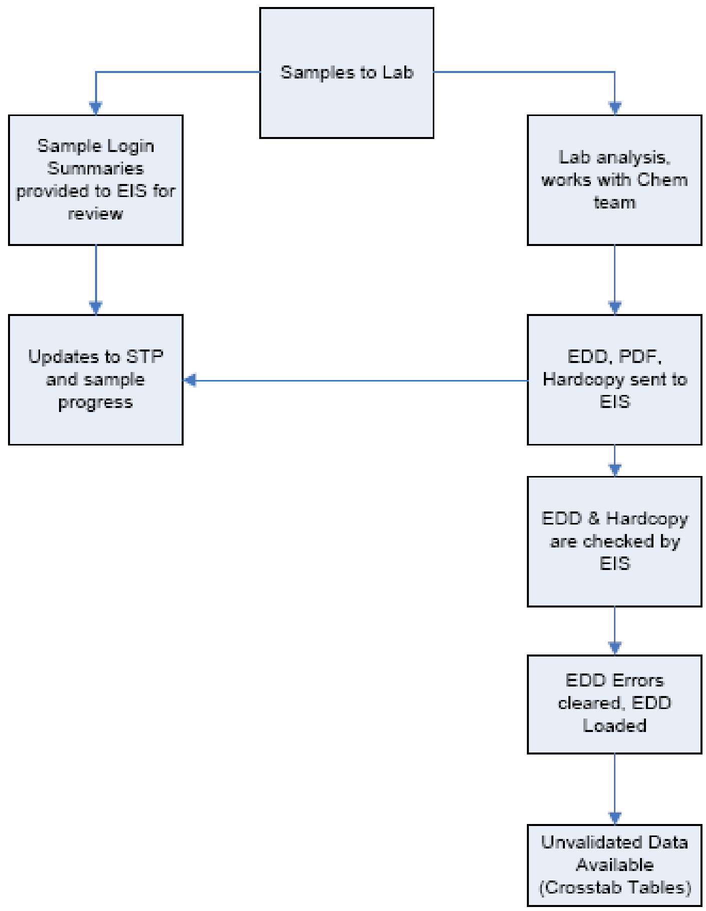


FIGURE 5
LABORATORY ANALYSIS

Samples will be analyzed as specified on the accompanying COC forms and in the Laboratory SOW. Generally, questions or noted inconsistencies identified by the laboratory should be addressed directly to the EIS.

The laboratory will attach the signed COCs to their hard copy data deliverables to officially relinquish control of the data back to the Environmental Contractor within the specified turn around time.

Hard copy data and EDDs will be reviewed to ensure that they are complete and acceptable as outlined in the EIS QC For Unvalidated Data Checklist. A 10% QC check will be performed on the analysis results to ensure that the hard copy data matches the EDD. All detected errors should be resolved with the laboratory.

Preliminary raw and detects tables will be generated following data import into VDMS by querying data with the VDMS XTab Tool and formatting the output with the Crosstab Cleanup and RDE Formatting Tools. A separate table must be created for each matrix, and provided to the PM for review.

Data archiving forms will be generated and affixed to each laboratory report received per Sample Delivery Group (SDG) for cataloguing, tracking, and archiving purposes.

The tools used to QC the laboratory's EDD are as follows:

- **CH-Analyzer**: Before the laboratory analytical data is entered into VDMS, the laboratory EDD must be processed through CH2M HILL's CH-Analyzer Microsoft Access database application. The CH-Analyzer application includes several automated diagnostic checks to verify format and content compliance with EDD specifications. The analytical laboratory must correct any errors before transmitting the EDD to CH2M HILL. The laboratory will forward the CH-Analyzer report, checked EDD, and hard copy of the data to the EIS who will manage the EDD verification process and data entry to VDMS.
- The EDD will be checked again using CH-Analyzer to verify correct format and content. If errors are found, the file will be returned to the laboratory for correction and re-submittal. Even if the formatting of the EDD is completely correct, the data loader may reject the EDD if the contents of the file do not comply with the data library standardization requirements.
- The CH-Analyzer also should be used to compare COCs, hard copy, and EDD content, and resolve discrepancies and document data error issues (for example, EDD re-submissions, turnaround time problems, hard copy incompleteness). These checks ensure the consistency and the validity of the EDD's content before the data are electronically transferred to VDMS. The objective of using the CH-Analyzer is to ensure that the validation process is performed on consistently high-quality data and minimize the chance of finding data errors later in the validation process, which would require the laboratory to resend corrected data and start the validation process over again.
- **VDMS**: Once the EDD verification is complete, it is electronically transferred into CH2M HILL's VDMS tool for data quality verification and validation according to project specifications. During import, the data are checked against a list of valid values. Once all error messages are resolved, validation can begin.

4.4 Data Validation

The data validator will be notified by the PC in advance of when to expect data and of any samples or analyses that should not be validated. (i.e. grain size should not be validated). For internal data validation, the EIS will notify the PC of data availability, and provide the hardcopy data and a QC Association Table.

Upon receipt of data from CH2M HILL, data validation will be performed in accordance with the Data Validation SOW, UFP SAP, and any other documents required. Generally, questions or noted inconsistencies identified by the validator should be addressed directly to laboratory, with the PC notified of issues and resolutions identified.

4.4.1 External Data Validation

For external data validation, a subset of the analytical data will be loaded into the 3rd Party DV Tool, a CH2M HILL Microsoft Access database designed for external data validation. The tool will allow external data validators to configure various with tables with QC information, associated validation logic, and qualifiers applied when QC criteria are not achieved. Qualifier criteria will be based on the Quality Assurance Project Plan.

The hard copy data, 3rd Party DV Tool, and a QC Association Table will be provided to the data validator. The PC will coordinate the return of the data package to CH2M HILL for archiving with the data validator.

Data Validators will provide the following materials to the PC within the required turn around time:

- Hardcopy Data Validation Report
- Validated Version of 3rd Party DV Tool (external validation)
- Validated Version of Data in VDMS (internal validation)

Once returned to CH2M HILL, the data in VDMS will be updated with the results in the 3rd Party DV Tool. The validated data will be reviewed by the PC to ensure that they are complete and acceptable as outlined in the VDMS and Chemist PreLoad Checklist. A 100% QC check will be performed on the validated results to ensure that the hard copy data matches the EDD. All detected errors should be resolved with the data validator.

Data archiving forms will be generated and affixed to each Data Validation Report per SDG received for cataloguing, tracking, and archiving purposes.

Validated raw and detects tables will be generated by querying data with the VDMS XTab Tool and formatting the output with the Crosstab Cleanup and RDE Formatting Tools. A separate table must be created for each matrix, and provided to the PM for review.

4.4.2 Internal Data Validation

VDMS will be operated in a semi-automated mode, which will require the chemist to configure various with tables with QC information, associated validation logic, and qualifiers applied when QC criteria are not achieved. Qualifier criteria will be based on the Quality Assurance Project Plan. A hardcopy data validation report will be generated. Data archiving forms will be generated and affixed to each Data Validation Report per SDG validated for cataloguing, tracking, and archiving purposes

Validated raw and detects tables will be generated by querying data with the VDMS XTab Tool and formatting the output with the Crosstab Cleanup and RDE Formatting Tools. A separate table must be created for each matrix, and provided to the PM for review.

4.4.3 Unvalidated Data Preload Check

Occasionally, unvalidated data will need to be loaded into the database. Although this data will not be validated, it will undergo a basic Preload Check by the PC to ensure laboratory compliance with project guidelines and determine results to be reported as the best result where multiple runs were conducted for a given sample/analysis. The PCL will provide input and oversight to ensure that data flags are applied correctly by the PC.

4.4.4 Senior Review

The PCL will verify that the validated hardcopy data and data contained in VDMS are complete and acceptable. Any identified discrepancies will be resolved with the assistance of the PC, EIS, laboratory, or validator as needed.

4.5 Data Preparation and Loading

Once the data are validated and approved by the PCL, they are exported from VDMS to the project warehouse. Field and laboratory data are merged into a format that is amenable to the warehouse. The backbone is a SQL-server-based data warehouse. Data in the warehouse are accessible through Site Information Management System (SIMS), a Web-based GIS application that allows users to query the data through a graphical interface and the XTabReports Tool.

4.5.1 Data Preparation

As part of the normal process of loading data into the warehouse, data standardization tasks must be completed. A Database Specialist (DBS) will load data into the warehouse using the following two programs: CH-ERPTool and CH-IMPTool. The CH-ERPTool runs an extensive series of logical QC checks and formats the data to be compatible with the data warehouse structure.

4.5.2 Data Loading

CH2M HILL Loading

The CH-IMPTool runs an additional series of QC checks and adds project-specific formatting and valid values, and loads the data into the warehouse. The following tasks need to be completed to load the data for project use:

- **Unit Standardization:** Analytical units and the associated results, reporting limits, and method detection limits will need to be converted to a consistent set of units as required by the project.
- **Resolve Reanalysis and Dilutions:** All samples that had an associated reanalysis or dilution run by the laboratory must have all of the excluded or rejected results marked as not the best result for reporting.
- **Resolve Analytical Overlap and Split Samples:** Analytical overlap occurs when a sample is analyzed by two or more methods that report the same analyte. To resolve this, the following logic is used to select the usable result:
  - If the overlapping results are all non-detections, the lowest non-detection result is selected.
  - If the overlapping results are all detected, the highest detected result is selected.

  - If the overlapping results consist of a mixture of detections and non-detections, the highest detected result is selected.

When data are loaded into the warehouse, an automated script will run to identify the "best" result when more than one analytical result exists.

NIRIS Loading

All Navy CLEAN and Joint Venture data must be loaded into NIRIS. Following the successful loading of data into the data warehouse, the DBS will use the NEDD Creator Tool to generate project NIRIS Electronic Data Deliverables (NEDD) files.

The DBS will use NIRIS's Data Checker Loader Tool to QC and submit the project NEDD files into NIRIS. The NIRIS Regional Database Manager (RDM) will load the data into NIRIS, and will work with the DBS to resolve any potential issue that may arise during loading. Following notification of successful data loading from the RDM, the DBS will query the data from NIRIS for review to ensure data integrity and accuracy.

4.5.3 Data Warehouse

The data warehouse is a Microsoft SQL Server 2005 relational database. This database, and all other "CH" tools used, has a data structure designed to achieve compliance with the Environmental Restoration Program Information Management System (ERPIMS) standard specified by Air Force Center for Engineering and the Environment (AFCEE). ERPIMS is an effective, comprehensive standard for environmental management.

The warehouse will use valid value tables when applying reference attributes to project data. Such reference data include the names of site objects and sampling locations, sampling matrix and method categories, analyte names, units. These reference tables are critical for maintaining the completeness and accuracy of data sets and are essential for accurate querying of the data.

Data are loaded and stored so that relationships among categories of data are enforced. For instance, all sampling records must be associated with a valid site object such as a planned sediment sampling location. The project repository database and collection, analysis, and reporting tools used in the DBMS are designed to enforce, for any project data record, entries in fields that refer to other types of data as required by the overall data model.

The data warehouse will automatically update the SIMS application whenever data are added or changed.

4.6 Data Reporting

Data reporting includes the following tasks:

- Retrieving data from the data warehouse for project deliverables, data visualization, or consumption by third parties
- Reviewing initial data and producing data queries and draft reports to dissect and disassemble the data
- Producing any requested client and regulatory agency data deliverables

Data for project deliverables, data visualization, or consumption by third parties will be retrieved from the warehouse, and will be equivalent to the real-time state of the project repository database. PMs and GIS Analysts (GAs) will work with the EIS and PCL for quality queries and data for reports.

4.6.1 Tables, Figures, and Diagrams

Once the data have been sufficiently analyzed, the list of requested data reports (tables, figures, diagrams) can be developed and finalized by the project team and submitted to the PCL and PM for review.

All requests for figures or graphics are to be directed to the GA assigned as the Point of Contact (POC) for that particular Navy installation. All requests for analytical data (crosstab tables, data dumps, third party deliverables etc) should be directed to the EIS assigned as the POC for that particular Navy installation. The EIS will generate a data deliverable from the data warehouse or NIRIS (as needed) suitable for end use and will provide data support to the end user. All requests for data statistics and calculations should be directed to the Risk Assessor assigned to the project.

4.6.2 GIS

The Navy CLEAN program will utilize ESRI's suite of GIS software for the majority of GIS-related tasks. The GIS data model will consist of one or more geodatabases (GDBs) per installation. Each installation will maintain one common installation GDB, which will store the common infrastructure data such as buildings, roads, topography, hyrdography, utilities, etc. The common installation GDB should adhere, as much as possible, to the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) data model. All project specific GDBs shall be developed and named for ease of interpretation by the GA.

All station location information for each installation will be pulled directly from that installation's data warehouse and stored in the common installation GDB as a data table. The data warehouse must contain valid coordinate information for the locations to be displayed correctly. Valid coordinate information will be maintained in the data warehouse by the EIS, and updated as necessary by the DBS.

ESRI's ArcMap 9.3 (or the latest version available) will be utilized for spatially displaying the environmental data within maps and figures, as well as for spatial analysis. The GA will need to coordinate efforts with the EIS on all requests that require the display of environmental sample data on a map to ensure that the appropriate data is queried from the data warehouse and linked to the appropriate station location table within the GIS.

4.6.3 Site Information Management System

This is currently not being used on the Navy CLEAN and Joint Venture Programs.

SIMS is a tool for publishing data of sufficient quality from the project. However, the project data warehouse will remain the database of record for the project.

SIMS provides many standard report formats, all of which are used in conjunction with the Query Tool feature, to isolate and retrieve information. Users can generate and save their queries using a graphical point-and-click tool. Reports in a wide variety of formats also can be requested and produced.

4.6.4 Legacy Data

Legacy data are those collected from any contractor other than CH2M HILL and data collected by CH2M HILL that have not been managed in accordance with Navy CLEAN and Joint Venture Program requirements. Legacy data are commonly compiled from various electronic and hard copy sources including spreadsheets, databases, technical reports, and laboratory hard copy data reports. When working with legacy data, usability assessment must be completed for the project team to be able to use the data with confidence. In order to assess the data properly, the legacy data needs to be evaluated by skilled professionals that are familiar with the type of data being evaluated so that any errors identified in the data can be corrected when possible or qualified in a manner to reflect the limitations of the data's use.

The PM has overall responsibility for the selection for inclusion of legacy data into the data management process. The PDL and PCL will work with the PM to establish the data review and import process, compile a comprehensive data inventory, and identify staff to facilitate data review.

The PDL and PCL will work with the EIS to determine the appropriate intermediary files and tools used to collect the data. The PDL and PCL will oversee the data review and flagging process and approve the data for upload into the Data Warehouse. The EIS is responsible for assembling the field and laboratory data in formats that facilitate data review, aid the PDL and PCL in overseeing the data review and flagging process, schedule, conversion of the data to the proper data warehouse format, and then loading the data into the Data Warehouse after approval by the PDL and PCL.

The GA, PDL, PCL, and PM have the primary responsibility for reviewing the data in their area of expertise and providing the PCL with data usability flags to be associated with each record.

SECTION 5
Project Closeout

The project completion/closeout phase includes the following:

- Archive hard copy and electronic documents
- Conduct project closeout meeting

5.1 Archive Procedures

A large variety of technical data will be generated during the field investigations. The EIS and PC will collect all hard copy and electronic data they are responsible for and verify that the incoming records are legible and in suitable condition for storage. Record storage will be performed in two stages:

- Storage during the project
- Permanent storage following project completion

During the project, CH2M HILL will store data hardcopy reports in CH2M HILL offices. Physical records will be secured in steel file cabinets or shelves, and labelled with the appropriate project identification. Electronic data will be maintained on CH2M HILL's corporate local area network servers.

Information generated from field activities will be documented on appropriate forms and will be maintained in the project file. These include COC records, field logbooks, well construction forms, boring logs, location sketches, and site photographs. In addition, notes from project meetings and telephone conversations will be filed.

Following project completion, both hard copy and electronic data deliverables will be archived. Team staff will provide all hard copies of laboratory and validation reports to the Data Closeout Coordinator to be prepped and shipped to Stone Mountain for archiving. Final laboratory EDDs and loading files will be provided to the PDL, to be archived on CH2M HILL's corporate local area network servers.

Any modifications made to the tools will be communicated to the project team via e-mail. As revisions are finalized, they will be distributed electronically to all users. After revision, it is the user's responsibility to conform to revised portions of the DMP.

5.2 Invoice Review and Approval

The EIS is responsible for tracking all data deliverables throughout the data management process to ensure that the project schedule is maintained, subcontractors comply with all required turn around times, and data provided are complete and acceptable. Following project completion, EISs are to review and provide comments on all laboratory and data validator invoices regarding data quality and schedule compliance prior to approval by the PM.

5.3 Project Closeout

At the end of each project, the PM will notify team staff of project closeout. The PM will coordinate and verify that all pertinent data has been archived. The PM may also review lessons learned, suggest process improvements, or revisions to the DMP and other project documentation as deemed necessary.

Appendix A
Workflow Process

Environmental Data Management Work Process

1.0 Project Planning & Setup	2.0 Sample Collection & Management	3.0 Lab Analysis	4.0 Data Validation	5.0 Data Management	6.0 Data Evaluation & Reporting
1.1 Project Setup	2.1 Sample Management	3.1 Sample Analysis	4.1 Internal Chemical Data Validation	5.1 CH2M HILL Data	6.1 Data Prep & Processing for Reporting
1.2 QAPP, SAP, DMP, DQOs Integration	2.2 Sample Collection	3.2 EDD Management	4.2 External Chemical Data Validation	5.2 Other Contractor & Legacy Data	6.2 Tabular Data Queries & Reports
1.3 Laboratory Setup	2.3 Sample Data Management	3.3 Hard Copy Management	4.3 Senior Review of Validated Data	5.3 Database Maintenance & Administration	6.3 Field Logs and Graphs
1.4 Database Setup					6.4 GIS Queries and Maps

Appendix B
Life of a Sample

A Sample's Life

Step-by-Step Outline of Navy CLEAN and JV Data Management Process, and Roles & Responsibilities

Step 1 — Planning Phase

- Staffing Schedules
- Kickoff Meeting – Include the EIS & PC
- Project Instructions (PIs)
  - Sample Nomenclature provided in table
  - Reviewed by DMC (Chelsea Bennet) or Database Specialist

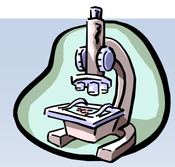
Step 2A — Sample Collection

- Daily collection and shipments of samples
- One COC/cooler; One FedEx slip/cooler
- Coordinate w/ EIS for tracking & Lab notification
- GPS conducted (if applicable)

Step 2B — Sample Tracking

- EIS cross checks COC against PIs
- Also reviews lab confirmation sheets to verify all samples were received and in appropriate condition

Step 3 — Lab Analysis



- Standard 28-day unless otherwise arranged
- EIS reviews data for accuracy and works with lab to resolve discrepancies
- EIS tracks schedule and keeps PM informed
- EIS inputs STSP information from Log Books
- EIS can generate Unvalidated Raw and Detects Data Tables

Step 4 — Data Validation

- PC reviews all data for accuracy against the PIs
- PC sends data from lab to Data Validator
- Delays may occur if there is missing data or data is late from the lab\
- EIS can generate Validated Raw and Detects Data Tables

Step 5 — Data Load

- PCL sends data to Database Specialist to be loaded into Environmental Database (EnDat)
- (Sometimes this involves assistance from PM, FTL, PC, and/or EIS)

Step 6 — Quality Assurance/ Quality Control

- EIS & PC are notified that data is loaded
- EIS verifies info loaded is correct (Sample, Station, Analyses, Result)
- EIS then helps decide whether info needs to be updated or not
- File and archive all Lab and DV deliverables

Step 7 — Report Generation

- Raw, Detects, Exceedance Reports
- Data Requests
- Exceedance Reports (criteria needed prior to this step and selected by PM)
- Human Health Risk Assessment
- Eco Risk Assessment

End of our Sample's Life?

- Data may be used in reports, posted on web, put into GIS, etc
- In that regard, a sample's life doesn't really ever end!
- Hopefully our sample had no exceedances and everyone is happy.

Appendix C

List of Standard Operating Procedures

Checklist - EIS Project Start-up Questions

Checklist - EIS QC for Unvalidated Data

Checklist - Generating RDE Tables

Checklist - Historic Data Cleanup

Checklist - VDMS DM Process

SOP-103 - Sample Tracking Program

SOP-107 - CH-Analyzer

SOP-109 - VDMS Validation

SOP-113 - CHERP Tool

SOP-114 - CHIMPTool

SOP-115 - VDMS Importing

SOP-126 - XTab Reports Tool

SOP - Access To NIRIS

SOP - Cherry Point Exceedance Formatting Wizard

SOP - Corrections To File

SOP - Data Archiving Procedures

SOP - Data Shipping

SOP - NEDD Creator Tool

Attachment 3
DoD Environmental Laboratory Accreditation Program Certification

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - JACKSONVILLE

Jacksonville, FL

for technical competence in the field of

Environmental Testing

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

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

Presented this 29th day of March 2010.

President & CEO
For the Accreditation Council
Certificate Number 3000.02
Valid to April 30, 2012

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

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

ENVIRONMENTAL

Valid To: April 30, 2012   Certificate Number: 3000.02

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

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Isopropyl alcohol (2-Propanol)	EPA 8015C	---------------------------	ENCO VGCMS-07
4-Ethyltoluene	----------------------------------	---------------------------	ENCO VGCMS-07
Cyclohexane	EPA 8260B	EPA 8260B	ENCO VGCMS-07
1,1,1-Trichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,2,2-Tetrachloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	EPA 8260B	EPA TO-14A
1,1,2-Trichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1-Dichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1-Dichloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichloro-1,1,2,2-tetrafluoroethane	---------------------------	---------------------------	EPA TO-14A
1,3-Butadiene	---------------------------	---------------------------	EPA TO-15
1,4-Dioxane	EPA 8260B	EPA 8260B	EPA TO-15
2,2,4-Trimethylpentane	NA	---------------------------	EPA TO-15
Benzyl chloride	----------------------------------	---------------------------	EPA TO-15
n-Hexane	----------------------------------	---------------------------	EPA TO-15
2-Hydroxy isobutyric acid	ENCO VGC-13	---------------------------	---------------------------
Acetic acid	ENCO VGC-13	---------------------------	---------------------------
Butyric acid (Butanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Hexanoic acid	ENCO VGC-13	---------------------------	---------------------------

Peter Mlnyer

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Isohexanoic acid (4-methyl-pentanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Isopentanoic acid (3-methyl-butanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Lactic acid	ENCO VGC-13	---------------------------	---------------------------
Pentanoic acid	ENCO VGC-13	---------------------------	---------------------------
Propionic acid (Propanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Pyruvic acid	ENCO VGC-13	---------------------------	---------------------------
Propylene glycol	ENCO VGC-18	---------------------------	---------------------------
Ethyl acetate	EPA 8015C	---------------------------	ENCO VGCMS-07
Ethylene glycol	EPA 8015C	---------------------------	---------------------------
Gasoline range organics (GRO)	EPA 8015C	EPA 8015C	---------------------------
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015C, 8260B	EPA 8260B	---------------------------
Methanol	EPA 8015C	---------------------------	---------------------------
n-Butyl alcohol	EPA 8015C	---------------------------	---------------------------
n-Propanol	EPA 8015C	---------------------------	---------------------------
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504, 504.1, 8011, 8260	EPA 8260B	---------------------------
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504, 504.1, 8011, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,2-Dichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichloropropane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,3-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,4-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
2-Chloroethyl vinyl ether	EPA 624, 8260B	EPA 8260B	---------------------------
Acrolein (Propenal)	EPA 624, 8260B	EPA 8260B	---------------------------
Acrylonitrile	EPA 624, 8260B	EPA 8260B	---------------------------
Benzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Bromodichloromethane	EPA 624, 8260B	EPA 8260B	ENCO VGCMS-07
Bromoform	EPA 624, 8260B	EPA 8260B	EPA TO-15
Carbon tetrachloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chlorobenzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chloroform	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
cis-1,3-Dichloropropene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Dibromochloromethane	EPA 624, 8260B	EPA 8260B	ENCO VGCMS-07
Ethylbenzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methyl bromide (Bromomethane)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methyl chloride (Chloromethane)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methylene chloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Tetrachloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Toluene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
trans-1,2-Dichloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-15
trans-1,3-Dichloropropylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Trichloroethene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Trichlorofluoromethane	EPA 624, 8260B	EPA 8260B	EPA-TO-14A

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Vinyl chloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Xylene (total)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B	---------------------------
1,1-Dichloropropene	EPA 8260B	EPA 8260B	---------------------------
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B	---------------------------
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B	---------------------------
1,2,4-Trichlorobenzene	EPA 625, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3-Dichloropropane	EPA 8260B	EPA 8260B	---------------------------
2,2-Dichloropropane	EPA 8260B	EPA 8260B	---------------------------
2-Butanone (Methyl ethyl ketone,MEK)	EPA 8015, 8260B	EPA 8260B	EPA TO-15
2-Chlorotoluene	EPA 8260B	EPA 8260B	NA
2-Hexanone	EPA 8260B	EPA 8260B	ENCO VGCMS-07
4-Chlorotoluene	EPA 8260B	EPA 8260B	---------------------------
4-Methyl-2-pentanone (MIBK)	EPA 8015C , 8260B	EPA 8260B	EPA TO-15
Acetone	EPA 8260B	EPA 8260B	---------------------------
Acetonitrile	EPA 8260B	EPA 8260B	---------------------------
Allyl chloride (3-Chloropropene)	EPA 8260B	EPA 8260B	EPA TO-15
Bromobenzene	EPA 8260B	EPA 8260B	---------------------------
Bromochloromethane	EPA 8260B	EPA 8260B	---------------------------
Carbon disulfide	EPA 8260B	EPA 8260B	EPA TO-15
Chloroprene	EPA 8260B	EPA 8260B	---------------------------
cis-1,2-Dichloroethylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Dibromomethane	EPA 8260B	EPA 8260B	---------------------------
Dichlorodifluoromethane	EPA 8260B	EPA 8260B	EPA TO-14A
Ethanol	EPA 8015, 8260B	EPA 8260B	---------------------------
Hexachlorobutadiene	EPA 625, 8260B, 8270D	EPA 8260, 8270	EPA TO-14A, EPA TO-15
Isopropylbenzene	EPA 8260B	EPA 8260B	---------------------------
Methacrylonitrile	EPA 8260B	EPA 8260B	---------------------------
Methyl methacrylate	EPA 8260B	EPA 8260B	---------------------------
Methyl tert-butyl ether (MTBE)	EPA 8260B	EPA 8260B	EPA TO-15
m-Xylene	EPA 8260B	EPA 8260B	---------------------------
Naphthalene	EPA 625, 8260B, 8270D, 8270D PAHSIM	EPA 8260B, 8270D, 8270D PAHSIM	---------------------------
n-Butyl benzene	EPA 8260B	EPA 8260B	---------------------------
n-Propyl benzene	EPA 8260B	EPA 8260B	---------------------------
o-Xylene	EPA 8260B	EPA 8260B	---------------------------
p-Isopropyltoluene	EPA 8260B	EPA 8260B	---------------------------
Propionitrile (Ethyl cyanide)	EPA 8260B	EPA 8260B	---------------------------
p-Xylene	EPA 8260B	EPA 8260B	---------------------------
sec-Butylbenzene	EPA 8260B	EPA 8260B	---------------------------
Styrene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
tert-Butylbenzene	EPA 8260B	EPA 8260B	---------------------------
trans-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B	---------------------------
Vinyl acetate	EPA 8260B	EPA 8260B	EPA TO-15
4,4'-DDD	EPA 608, 8081B	EPA 8081B	---------------------------
4,4'-DDE	EPA 608, 8081B	EPA 8081B	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
4,4'-DDT	EPA 608, 8081B	EPA 8081B	---------------------------
Aldrin	EPA 608, 8081B	EPA 8081B	---------------------------
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	---------------------------
Aroclor-1016(PCB-1016)	EPA 608, 8082A	EPA 8082A	---------------------------
Aroclor-1221(PCB-1221)	EPA 608, 8082A	EPA 8082A	---------------------------
Aroclor-1232(PCB-1232)	EPA 608, 8082A	EPA 8082A	---------------------------
Aroclor-1242(PCB-1242)	EPA 608, 8082A	EPA 8082A	---------------------------
Aroclor-1248(PCB-1248)	EPA 608, 8082A	EPA 8082A	---------------------------
Aroclor-1254(PCB-1254)	EPA 608, 8082A	EPA 8082A	---------------------------
Aroclor-1260(PCB-1260)	EPA 608, 8082A	EPA 8082A	---------------------------
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	---------------------------
Chlordane(tech.)	EPA 608, 8081B	EPA 8081B	---------------------------
delta-BHC	EPA 608, 8081B	EPA 8081B	---------------------------
Dieldrin	EPA 608, 8081B	EPA 8081B	---------------------------
Endosulfan I	EPA 608, 8081B	EPA 8081B	---------------------------
Endosulfan II	EPA 608, 8081B	EPA 8081B	---------------------------
Endosulfan sulfate	EPA 608, 8081B	EPA 8081B	---------------------------
Endrin	EPA 608, 8081B	EPA 8081B	---------------------------
Endrin aldehyde	EPA 608, 8081B	EPA 8081B	---------------------------
gamma-BHC (Lindane,gamma-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	---------------------------
Heptachlor	EPA 608, 8081B	EPA 8081B	---------------------------
Heptachlor epoxide	EPA 608, 8081B	EPA 8081B	---------------------------
Toxaphene (Chlorinated camphene)	EPA 608, 8081B	EPA 8081B	---------------------------
alpha-Chlordane	EPA 8081B	EPA 8081B	---------------------------
Endrin ketone	EPA 8081B	EPA 8081B	---------------------------
gamma-Chlordane	EPA 8081B	EPA 8081B	---------------------------
Isodrin	EPA 8081B, 8270D	EPA 8081B, 8270D	---------------------------
Methoxychlor	EPA 8081B	EPA 8081B	---------------------------
Mirex	EPA 8081B	EPA 8081B	---------------------------
Kepone	EPA 8270D	EPA 8270D	---------------------------
o,o,o-Triethylphosphorothioate	EPA 8270D	EPA 8270D	---------------------------
Parathion,ethyl	EPA 8270D	EPA 8270D	---------------------------
Phorate	EPA 8270D	EPA 8270D	---------------------------
Sulfotepp	EPA 8270D	EPA 8270D	---------------------------
Thionazin (Zinophos)	EPA 8270D	EPA 8270D	---------------------------
Dalapon	EPA 615, 8151A	EPA 8151A	---------------------------
3,5-DCBA	EPA 615, 8151A	EPA 8151A	---------------------------
4-Nitrophenol	EPA 615, 625, 8151A, 8270D	EPA 8270D, 8151A	---------------------------
Dicamba	EPA 615, 8151A	EPA 8151A	---------------------------
MCPP	EPA 615, 8151A	EPA 8151A	---------------------------
MCPA	EPA 615, 8151A	EPA 8151A	---------------------------
Dichlorprop	EPA 615, 8151A	EPA 8151A	---------------------------
2,4-D	EPA 615, 8151A	EPA 8151A	---------------------------
Pentachlorophenol	EPA 615, 625, 8151A, 8270D	EPA 8151A, 8270D	---------------------------
2,4,5-TP (Silvex)	EPA 615, 8151A	EPA 8151A	---------------------------
Chloramben	EPA 615, 8151A	EPA 8151A	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
2,4,5-T	EPA 615, 8151A	EPA 8151A	---------------------------
2,4-DB	EPA 615, 8151A	EPA 8151A	---------------------------
Bentazon	EPA 615, 8151A	EPA 8151A	---------------------------
Picloram	EPA 615, 8151A	EPA 8151A	---------------------------
Dinoseb	EPA 615, 625, 8151A, 8270D	EPA 8151A, 8270D	---------------------------
Dacthal	EPA 615, EPA 8151A	EPA 8151A	---------------------------
Acifluorfen	EPA 615, EPA 8151A	EPA 8151A	---------------------------
2,4-DCAA	EPA 615, EPA 8151A	EPA 8151A	---------------------------
Total coliforms	SM 9222B	---------------------------	---------------------------
Fecal coliforms	SM 9222D	---------------------------	---------------------------
Aluminum	EPA 200.7, 6010C	EPA 6010C	---------------------------
Antimony	EPA 200.7, 6010C	EPA 6010C	---------------------------
Arsenic	EPA 200.7, 6010C	EPA 6010C	---------------------------
Barium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Beryllium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Boron	EPA 200.7, 6010C	EPA 6010C	---------------------------
Cadmium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Calcium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Chromium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Cobalt	EPA 200.7, 6010C	EPA 6010C	---------------------------
Copper	EPA 200.7, 6010C	EPA 6010C	---------------------------
Hardness (calc.)	EPA 200.7, SM2340B	---------------------------	---------------------------
Iron	EPA 200.7, 6010C, SM 18 3500-Fe D	EPA 6010C	---------------------------
Lead	EPA 200.7, 6010C	EPA 6010C	---------------------------
Lithium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Magnesium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Manganese	EPA 200.7, 6010C	EPA 6010C	---------------------------
Molybdenum	EPA 200.7, 6010C	EPA 6010C	---------------------------
Nickel	EPA 200.7, 6010C	EPA 6010C	---------------------------
Potassium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Selenium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Silver	EPA 200.7, 6010C	EPA 6010C	---------------------------
Sodium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Strontium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Thallium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Tin	EPA 200.7, 6010C	EPA 6010C	---------------------------
Titanium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Vanadium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Zinc	EPA 200.7, 6010C	EPA 6010C	---------------------------
Mercury	EPA 245.1, 7470	EPA 7471	---------------------------
Sulfate	ASTM D516-90	---------------------------	---------------------------
Ignitability	EPA 1010	EPA 1010, EPA 1030	---------------------------
Conductivity	EPA 120.1, SM 18 2510B	---------------------------	---------------------------
Oil & Grease (HEM)	EPA 1664A	EPA 9071B	---------------------------
Total Petroleum Hydrocarbons (TPH) (HEM-SGT)	EPA 1664A	---------------------------	---------------------------
Turbidity	EPA 180.1, SM 18 2130B	---------------------------	---------------------------
Orthophosphate as P	EPA 365.3	---------------------------	---------------------------
Color	SM 2120B	---------------------------	---------------------------
Alkalinity as CaC03	SM 2320B	---------------------------	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Hardness	SM 2340C	---------------------------	---------------------------
Residue-nonfilterable (TSS)	SM 2540D	---------------------------	---------------------------
Residue-total	SM 2540B	---------------------------	---------------------------
Residue-filterable (TDS)	SM 2540C	---------------------------	---------------------------
Chromium VI	SM 3500-Cr D(18th/19th Ed.)/UV-VIS	---------------------------	---------------------------
Chloride	SM 4500-Cl C	---------------------------	---------------------------
Total residual chlorine	SM 4500-Cl G	---------------------------	---------------------------
pH	SM 18 4500-H+-B, EPA 9040	EPA 9040, 9045	---------------------------
Nitrite	SM 4500-NO_2 B	---------------------------	---------------------------
Biochemical oxygen demand	SM 5210B	---------------------------	---------------------------
Carbonaceous BOD(CBOD)	SM 5210B	---------------------------	---------------------------
Chemical oxygen demand	SM 5220D, EPA 410.4	---------------------------	---------------------------
Total Organic Carbon	SM 18 5310B, EPA 9060	---------------------------	---------------------------
Total Petroleum Hydrocarbons (TPH)	FL-PRO	FL-PRO	---------------------------
Carbon dioxide	RSK-175	---------------------------	---------------------------
Ethane	RSK-175	---------------------------	---------------------------
Ethylene	RSK-175	---------------------------	---------------------------
Methane	RSK-175	---------------------------	---------------------------
2,4,6-Trichlorophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dichlorophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dimethylphenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dinitrophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dinitrotoluene (2,4-DNT)	EPA 625, 8270D	EPA 8270D	---------------------------
2,6-Dinitrotoluene (2,6-DNT)	EPA 625, 8270D	EPA 8270D	---------------------------
2-Chloronaphthalene	EPA 625, 8270D	EPA 8270D	---------------------------
2-Chlorophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2-Methyl-4,6-dinitrophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2-Nitrophenol	EPA 625, 8270D	EPA 8270D	---------------------------
3,3'-Dichlorobenzidine	EPA 625, 8270D	EPA 8270D	---------------------------
4-Bromophenyl phenylether	EPA 625, 8270D	EPA 8270D	---------------------------
4-Chloro-3-methylphenol	EPA 625, 8270D	EPA 8270D	---------------------------
4-Chlorophenyl phenylether	EPA 625, 8270D	EPA 8270D	---------------------------
Acenaphthene	EPA 625, 8270D	EPA 8270D	---------------------------
Acenaphthylene	EPA 625, 8270D	EPA 8270D	---------------------------
Aniline	EPA 625, 8270D	EPA 8270D	---------------------------
Anthracene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzidine	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(a)anthracene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(a)pyrene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(b)fluoranthene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(g,h,i)perylene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(k)fluoranthene	EPA 625, 8270D	EPA 8270D	---------------------------
bis(2-Chloroethoxy)methane	EPA 625, 8270D	EPA 8270D	---------------------------
bis(2-Chloroethyl) ether	EPA 625, 8270D	EPA 8270D	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane)	EPA 625, 8270D	EPA 8270D	---------------------------
bis(2-Ethylhexyl) phthalate(DEHP)	EPA 625, 8270D	EPA 8270D	---------------------------
Butylbenzylphthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Chrysene	EPA 625, 8270D	EPA 8270D	---------------------------
Dibenzo(a,h)anthracene	EPA 625, 8270D	EPA 8270D	---------------------------
Diethyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Dimethyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Di-n-butyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Di-n-octyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Fluoranthene	EPA 625, 8270D	EPA 8270D	---------------------------
Fluorene	EPA 625, 8270D	EPA 8270D	---------------------------
Hexachlorobenzene	EPA 625, 8270D	EPA 8270D	---------------------------
Hexachlorocyclopentadiene	EPA 625, 8270D	EPA 8270D	---------------------------
Hexachloroethane	EPA 625, 8270D	EPA 8270D	---------------------------
Indeno(1,2,3-cd)pyrene	EPA 625, 8270D	EPA 8270D	---------------------------
Isophorone	EPA 625, 8270D	EPA 8270D	---------------------------
Nitrobenzene	EPA 625, 8270D	EPA 8270D	---------------------------
n-Nitrosodimethylamine	EPA 625, 8270D	EPA 8270D	---------------------------
n-Nitrosodi-n-propylamine	EPA 625, 8270D	EPA 8270D	---------------------------
n-Nitrosodiphenylamine	EPA 625, 8270D	EPA 8270D	---------------------------
Phenanthrene	EPA 625, 8270D	EPA 8270D	---------------------------
Phenol	EPA 625, 8270D	EPA 8270D	---------------------------
Pyrene	EPA 625, 8270D	EPA 8270D	---------------------------
Pyridine	EPA 625, 8270D	EPA 8270D	---------------------------
1,1-Biphenyl	EPA 8270D	EPA 8270D	---------------------------
1,2,4,5-Tetrachlorobenzene	EPA 8270D	EPA 8270D	---------------------------
1,2-Diphenylhydrazine	EPA 8270D	EPA 8270D	---------------------------
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	EPA 8270D	---------------------------
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	EPA 8270D	---------------------------
1,4-Naphthoquinone	EPA 8270D	EPA 8270D	---------------------------
1,4-Phenylenediamine	EPA 8270D	EPA 8270D	---------------------------
1-Methylnaphthalene	EPA 8270D	EPA 8270D	---------------------------
1-Naphthylamine	EPA 8270D	EPA 8270D	---------------------------
2,3,4,6-Tetrachlorophenol	EPA 8270D	EPA 8270D	---------------------------
2,4,5-Trichlorophenol	EPA 8270D	EPA 8270D	---------------------------
2,6-Dichlorophenol	EPA 8270D	EPA 8270D	---------------------------
2-Acetylaminofluorene	EPA 8270D	EPA 8270D	---------------------------
2-Methylnaphthalene	EPA 8270D	EPA 8270D	---------------------------
2-Methylphenol (o-Cresol)	EPA 8270D	EPA 8270D	---------------------------
2-Naphthylamine	EPA 8270D	EPA 8270D	---------------------------
2-Nitroaniline	EPA 8270D	EPA 8270D	---------------------------
2-Picoline (2-Methylpyridine)	EPA 8270D	EPA 8270D	---------------------------
3,3'-Dimethylbenzidine	EPA 8270D	EPA 8270D	---------------------------
3-Methylcholanthrene	EPA 8270D	EPA 8270D	---------------------------
3-Methylphenol (m-Cresol)	EPA 8270D	EPA 8270D	---------------------------
3-Nitroaniline	EPA 8270D	EPA 8270D	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
4-Aminobiphenyl	EPA 8270D	EPA 8270D	---------------------------
4-Chloroaniline	EPA 8270D	EPA 8270D	---------------------------
4-Dimethyl aminoazobenzene	EPA 8270D	EPA 8270D	---------------------------
4-Methylphenol (p-Cresol)	EPA 8270D	EPA 8270D	---------------------------
4-Nitroaniline	EPA 8270D	EPA 8270D	---------------------------
4-Nitroquinoline-n-oxide	EPA 8270D	EPA 8270D	---------------------------
5-Nitro-o-toluidine	EPA 8270D	EPA 8270D	---------------------------
7,12-Dimethylbenz(a)anthracene	EPA 8270D	EPA 8270D	---------------------------
a-a-Dimethylphenethylamine	EPA 8270D	EPA 8270D	---------------------------
Acetophenone	EPA 8270D	EPA 8270D	---------------------------
Aramite	EPA 8270D	EPA 8270D	---------------------------
Atrazine	EPA 8270D	EPA 8270D	---------------------------
Benzaldehyde	EPA 8270D	EPA 8270D	---------------------------
Benzoic acid	EPA 8270D	EPA 8270D	---------------------------
Benzyl alcohol	EPA 8270D	EPA 8270D	---------------------------
Caprolactam	EPA 8270D	EPA 8270D	---------------------------
Carbazole	EPA 8270D	EPA 8270D	---------------------------
Chlorobenzilate	EPA 8270D	EPA 8270D	---------------------------
Cresol, Total	EPA 8270D	EPA 8270D	---------------------------
Diallate	EPA 8270D	EPA 8270D	---------------------------
Dibenzo(a,h)pyrene	EPA 8270D	EPA 8270D	---------------------------
Dibenzofuran	EPA 8270D	EPA 8270D	---------------------------
Dimethoate	EPA 8270D	EPA 8270D	---------------------------
Diphenylamine	EPA 8270D	EPA 8270D	---------------------------
Disulfoton	EPA 8270D	EPA 8270D	---------------------------
DPH (as Azobenzene)	EPA 8270D	EPA 8270D	---------------------------
Ethyl methanesulfonate	EPA 8270D	EPA 8270D	---------------------------
Famphur	EPA 8270D	EPA 8270D	---------------------------
Hexachlorophene	EPA 8270D	EPA 8270D	---------------------------
Hexachloropropene	EPA 8270D	EPA 8270D	---------------------------
Isosafrole	EPA 8270D	EPA 8270D	---------------------------
Methapyrilene	EPA 8270D	EPA 8270D	---------------------------
Methyl methane sulfonate	EPA 8270D	EPA 8270D	---------------------------
Methyl parathion (Parathion,methyl)	EPA 8270D	EPA 8270D	---------------------------
Nitroquinoline-1-oxide	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosodiethylamine	EPA 8270D	EPA 8270D	---------------------------
n-Nitroso-di-n-butylamine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosomethylethylamine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosomorpholine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosopiperidine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosopyrrolidine	EPA 8270D	EPA 8270D	---------------------------
o-Toluidine	EPA 8270D	EPA 8270D	---------------------------
Pentachlorobenzene	EPA 8270D	EPA 8270D	---------------------------
Pentachloroethane	EPA 8270D	EPA 8270D	---------------------------
Pentachloronitrobenzene	EPA 8270D	EPA 8270D	---------------------------
Phenacetin	EPA 8270D	EPA 8270D	---------------------------
Pronamide (Kerb)	EPA 8270D	EPA 8270D	---------------------------
Safrole	EPA 8270D	EPA 8270D	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
C9-C18 Aliphatic Hydrocarbons	MAEPH	MAEPH	---------------------------
C19-C36 Aliphatic Hydrocarbons	MAEPH	MAEPH	---------------------------
C11-C22 Aromatic Hydrocarbons	MAEPH	MAEPH	---------------------------
Diesel Range Organics (DRO)	EPA 8015	EPA 8015	---------------------------
2-Methylnaphthalene	EPA 8270	EPA 8270	---------------------------
4-Methylphenol (p-Cresol)	EPA 8270	EPA 8270	---------------------------
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	EPA 1311	---------------------------
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	EPA 1312	---------------------------
Corrosivity (pH)	NA	EPA 9040	---------------------------
Paint Filter Liquids Test	NA	EPA 9095	---------------------------
Diethyl ether	EPA 8260	EPA 8260	---------------------------
Ethyl methacrylate	EPA 8260	EPA 8260	---------------------------
Iodomethane (Methyl iodide)	EPA 8260	EPA 8260	---------------------------
Methyl cyclohexane	EPA 8260	EPA 8260	---------------------------
Methyl acetate	EPA 8260	EPA 8260	---------------------------
Isopropyl ether	EPA 8260	EPA 8260	---------------------------

Analytical Method	Prep Method			
	Soil	Water	Air	Waste
EPA 8260B	EPA 5035	EPA 5030B	----------------	EPA 5035
EPA 624	---------------------	EPA 5030B	----------------	---------------------
EPA 625	---------------------	EPA 3510C	----------------	---------------------
EPA 8270D	EPA 3545A	EPA 3510C	----------------	EPA 3580A
EPA 200.7	---------------------	EPA 200.7	----------------	---------------------
EPA 6010C	EPA 3050B	EPA 3005A	----------------	EPA 3050B
EPA 608	---------------------	EPA 3510C	----------------	---------------------
EPA 8081B	EPA 3545A	EPA 3510C	----------------	EPA 3580A
EPA 8082A	EPA 3545A	EPA 3510C	----------------	EPA 3580A
EPA 615	---------------------	EPA 615	----------------	---------------------
EPA 8151A	EPA 8151A	EPA 8151	----------------	EPA 8151A
MA VPH, May 2004 Revision 1.1	EPA 5035	EPA 5030B	----------------	---------------------
MA EPH, May 2004 Revision 1.1	EPA 3545A	EPA 3510C	----------------	---------------------
FLPRO	EPA 3545A	EPA 3510C	----------------	---------------------
8015C – GRO	EPA 5035	EPA 5030B	----------------	---------------------
8015C – DRO	EPA 3545A	EPA 3510C	----------------	---------------------
TO14A	---------------------	-------------------	TO14A	---------------------
TO15	---------------------	-------------------	TO15	---------------------
SPLP	EPA 1312	EPA 1312	----------------	EPA 1312
TCLP	EPA 1311	EPA 1311	----------------	EPA 1311

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

for technical competence in the field of

Environmental Testing

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

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

Presented this 29h day of March 2010.

President & CEO
For the Accreditation Council
Certificate Number 3000.01
Valid to March 31, 2012

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ENVIRONMENTAL CONSERVATION LABORATORIES – ORLANDO
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Orlando, FL 32824
Dorian Pearson-Shaver Phone: 407 826 5314
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ENVIRONMENTAL

Valid To: March 31, 2012 Certificate Number: 3000.01

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

Testing Technologies

Analyte / Parameter	**Non-Potable Water**	**Solid Hazardous Waste**
Metals	EPA 6020A/200.8	EPA 6020A
Aluminum	EPA 6020A/200.8	EPA 6020A
Antimony	EPA 6020A/200.8	EPA 6020A
Arsenic	EPA 6020A/200.8	EPA 6020A
Barium	EPA 6020A/200.8	EPA 6020A
Beryllium	EPA 6020A/200.8	EPA 6020A
Cadmium	EPA 6020A/200.8	EPA 6020A
Calcium	EPA 6020A/200.8	EPA 6020A
Chromium	EPA 6020A/200.8	EPA 6020A
Cobalt	EPA 6020A/200.8	EPA 6020A
Copper	EPA 6020A/200.8	EPA 6020A
Hardness	SM 2340 B	-----------------------------------
Iron	EPA 6020A/200.8	EPA 6020A
Lead	EPA 6020A/200.8	EPA 6020A
Magnesium	EPA 6020A/200.8	EPA 6020A
Manganese	EPA 6020A/200.8	EPA 6020A
Mercury	EPA 245.1/7470A	EPA 7471B
Molybdenum	EPA 6020A/200.8	EPA 6020A
Nickel	EPA 6020A/200.8	EPA 6020A
Potassium	EPA 6020A/200.8	EPA 6020A
Selenium	EPA 6020A/200.8	EPA 6020A
Silver	EPA 6020A/200.8	EPA 6020A

Analyte / Parameter	**Non-Potable Water**	**Solid Hazardous Waste**
Sodium	EPA 6020A/200.8	EPA 6020A
Thallium	EPA 6020A/200.8	EPA 6020A
Tin	EPA 6020A/200.8	EPA 6020A
Titanium	EPA 6020A/200.8	EPA 6020A
Vanadium	EPA 6020A/200.8	EPA 6020A
Zinc	EPA 6020A/200.8	EPA 6020A
Microbiology		
Total Coliforms	SM 9222B	----------------------------------
Fecal Coliforms	SM 9222D	----------------------------------
General Chemistry		
Acidity, as $CaC0_3$	EPA 305.1/SM 2310 B (4A)	----------------------------------
Alkalinity as $CaC0_3$	EPA 310.1/SM 2320 B	EPA 310.1/SM 2320 B
Alkalinity as $CaC0_4$	EPA 310.2	EPA 310.2
Ammonia as N	----------------------------------	EPA 350.1
Biochemical oxygen demand	EPA 405.1/SM 5210 B	----------------------------------
Bromide	EPA 300.0/9056A	EPA 9056A
Carbonaceous BOD (CBOD)	SM 5210 B	----------------------------------
Chemical oxygen demand	EPA 410.4	----------------------------------
Chloride	EPA 300.0/9056A	EPA 9056A
Chromium VI	EPA 7196/ SM 3500-Cr D	EPA 7196
Conductivity	EPA 120.1	----------------------------------
Cyanide	EPA 335.2/SM 4500-CN E	EPA 9014
Ferric iron (calculated)	SM 3500-Fe D	----------------------------------
Ferrous iron	SM 3500-Fe D	----------------------------------
Fluoride	EPA 300.0/9056A	EPA 9056A
Hardness	EPA 130.2/SM 2340 C	----------------------------------
Kjeldahl nitrogen -total	EPA 351.2	EPA351.2
Nitrate as N	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrate-nitrite	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrite as N	EPA 300.0/354.1/9056A/SM 4500-NO_2 B	EPA 9056A/ SM 4500-NO_2 B
Organic nitrogen	EPA 351.2/350.1	EPA 351.2/350.1
Orthophosphate as P	EPA 365.1	----------------------------------
Orthophosphate as P	EPA 365.3	----------------------------------
pH	EPA 150.1/9040C/SM 4500-H^+-B	EPA 9040C
Phosphorus, total	EPA 365.4	EPA 365.4
Residue-filterable (TDS)	SM 2540 C	----------------------------------
Residue-nonfilterable (TSS)	SM 2540 D	----------------------------------
Residue-total	SM 2540 B/SM 2540 G/EPA 160.3	SM 2540G/EPA 160.3
Residue-volatile	EPA 160.4	EPA 160.4
Sulfate	EPA 300.0/9056A	EPA 9056A
Sulfide	EPA 376.1/SM 4500-S E	----------------------------------
Surfactants -MBAS	SM 5540 C	----------------------------------
Total nitrate-nitrite	EPA 9056 A/SM 4500-$N0_3$ H	EPA 9056 A/SM 4500-$N0_3$ H
Total cyanide	EPA 9014	EPA 9014
Total nitrogen	TKN + Total nitrate-nitrite	TKN + Total nitrate-nitrite
Total Organic Carbon	EPA 9060A/SM 5310B	TOC Walkley Black
Total phenolics	EPA 420.1	EPA 420.1
Total, fixed, and volatile residue	SM 2540 G	SM 2540 G
Turbidity	EPA 180.1	----------------------------------

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Un-ionized ammonia	DEP SOP 10/03/83	DEP SOP 10/03/83
Extractable Organics		
1,2,4-Trichlorobenzene	EPA 8270D/625	EPA 8270D
1,2,4,5-Tetrachlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D/625	EPA 8270D
2,3,4,6-Tetrachlorophenol	EPA 8270D/625	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dimethylphenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrophenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D/625/ Scan-Sim	EPA 8270D
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D/625	EPA 8270D
2-Chloronaphthalene	EPA 8270D/625	EPA 8270D
2-Chlorophenol	EPA 8270D/625	EPA 8270D
2·Methyl-4,6-dinitrophenol	EPA 8270D/625	EPA 8270D
2-Methylnaphthalene	EPA 8270D/625	EPA 8270D
2-Methylphenol (o-Cresol)	EPA 8270D/625	EPA 8270D
2-Nitroaniline	EPA 8270D/625	EPA 8270D
2-Nitrophenol	EPA 8270D/625	EPA 8270D
3,3'-Dichlorobenzidine	EPA 8270D/625	EPA 8270D
3/4-Methylphenols (m/p-Cresols)	EPA 8270D/625	EPA 8270D
3-Nitroaniline	EPA 8270D/625	EPA 8270D
4-Bromophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D/625	EPA 8270D
4-Chloroaniline	EPA 8270D/625	EPA 8270D
4-Chlorophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Nitrophenol	EPA 8270D/625	EPA 8270D
Acenaphthene	EPA 8270D/625	EPA 8270D
Acenaphthylene	EPA 8270D/625	EPA 8270D
4-Melhylphenol (p-Cresol)	EPA 8270D/625	EPA 8270D
4-Nitroaniline	EPA 8270D/625	EPA 8270D
Acetophenone	EPA 8270D/625	EPA 8270D
Anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Atrazine	EPA 8270D/625	EPA 8270D
Benzaldehyde	EPA 8270D/625	EPA 8270D
Benzidine	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(a)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(a)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(b)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(g,h,i)perylene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(k)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D
1,1-Biphenyl	EPA 8270D/625	EPA 8270D
bis(2-Chloroethoxy) methane	EPA 8270D/625	EPA 8270D
bis(2-Chloroethyl) ether	EPA 8270D/625	EPA 8270D
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270D/625	EPA 8270D
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Butyl benzyl phthalate	EPA 8270D/625	EPA 8270D
Caprolactam	EPA 8270D/625	EPA 8270D
Carbazole	EPA 8270D/625	EPA 8270D
Chrysene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Dibenz(a,h)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Dibenzofuran	EPA 8270D/625	EPA 8270D
Diethyl phthalate	EPA 8270D/625	EPA 8270D
Dimethyl phthalate	EPA 8270D/625/ Scan-Sim	EPA 8270D
Di-n-butyl phthalate	EPA 8270D/625	EPA 8270D
Di-n-octyl phthalate	EPA 8270D/625	EPA 8270D
Fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Fluorene	EPA 8270D/625	EPA 8270D
Hexachlorobenzene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorobutadiene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D/625	EPA 8270D
Hexachloroethane	EPA 8270D/625	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Isodrin	EPA 8270D/625	EPA 8270D
Isophorone	EPA 8270D/625	EPA 8270D
Naphthalene	EPA 8270D/625	EPA 8270D
Nitrobenzene	EPA 8270D/625	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D/625	EPA 8270D
Pentachlorophenol	EPA 8270D/625/ Scan-Sim	EPA 8270D
Phenanthrene	EPA 8270D/625	EPA 8270D
Phenol	EPA 8270D/625	EPA 8270D
Pyrene	EPA 8270D/625	EPA 8270D
Total Petroleum Hydrocarbons (TPH)	FL·PRO	FL·PRO
Volatile Organics		
1,1,1,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethene	EPA 8260B/624	EPA 8260B
1,1-Dichloropropene	EPA 8260B/624	EPA 8260B
1,2,3-Trichlorobenzene	EPA 504.1/8260B/624	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B/624	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/624	EPA 8260B
1,2,4-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504 /504.1/8011/8260B	EPA 8260B
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504 /504.1/8011/8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,2-Dichloroethane	EPA 8260B/624	EPA 8260B
1,2-Dichloropropane	EPA 8260B/624	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
1,3-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,3-Dichloropropane	EPA 8260B/624	EPA 8260B
1,4-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,4-Dioxane (1,4-Diethylencoxide)	EPA 8260B/624	EPA 8260B
2,2-Dichloropropane	EPA 8260B/624	EPA 8260B
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B/624	EPA 8260B
2-Chloroethyl vinyl ether	EPA 8260B/624	EPA 8260B
2-Chlorotoluene	EPA 8260B/624	EPA 8260B
2-Hexanone	EPA 8260B/624	EPA 8260B
4-Chlorotoluene	EPA 8260B/624	EPA 8260B
4-Methyl-2-pentanone (MIBK)	EPA 8260B/624	EPA 8260B
Acetone	EPA 8260B/624	EPA 8260B
Acetonitrile	EPA 8260B/624	EPA 8260B
Acrolein (Propenal)	EPA 8260B/624	EPA 8260B
Acrylonitrile	EPA 8260B/624	EPA 8260B
Allyl chloride (3-Chloropropene)	EPA 8260B/624	EPA 8260B
Benzene	EPA 8260B/624	EPA 8260B
Bromobenzene	EPA 8260B/624	EPA 8260B
Bromochloromethane	EPA 8260B/624	EPA 8260B
Bromodichloromethane	EPA 8260B/624	EPA 8260B
Bromoform	EPA 8260B/624	EPA 8260B
Carbon tetrachloride	EPA 8260B/624	EPA 8260B
Carbon disulfide	EPA 8260B/624	EPA 8260B
Chlorobenzene	EPA 8260B/624	EPA 8260B
Chloroethane	EPA 8260B/624	EPA 8260B
Chloroform	EPA 8260B/624	EPA 8260B
Chloroprene	EPA 8260B/624	EPA 8260B
cis-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
cis-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
Cyclohexane	EPA 8260B/624	EPA 8260B
Dibromochloromethane	EPA 8260B/624	EPA 8260B
Dibromomethane	EPA 8260B/624	EPA 8260B
Dichlorodifluoromethane	EPA 8260B/624	EPA 8260B
Ethyl methacrylate	EPA 8260B/624	EPA 8260B
Hexachlorobutadiene	EPA 8260B/624	EPA 8260B
Ethylbenzene	EPA 8260B/624	EPA 8260B
Iodomethane (Methyl iodide)	EPA 8260B/624	EPA 8260B
Isobutyl alcohol (2-Methyl-l-propanol)	EPA 8260B/624	EPA 8260B
Isopropylbenzene	EPA 8260B/624	EPA 8260B
m+p-Xylenes	EPA 8260B/624	EPA 8260B
Methacrylonitrile	EPA 8260B/624	EPA 8260B
Methyl acetate	EPA 8260B/624	EPA 8260B
Methyl bromide (Bromomethane)	EPA 8260B/624	EPA 8260B
Methyl chloride (Chloromethane)	EPA 8260B/624	EPA 8260B
Methyl methacrylate	EPA 8260B/624	EPA 8260B
Methyl tert-butyl ether (MTBE)	EPA 8260B/624	EPA 8260B
Methylcyclohexane	EPA 8260B/624	EPA 8260B
Methylene chloride	EPA 8260B/624	EPA 8260B
Naphthalene	EPA 8260B/624	EPA 8260B
n-Butylbenzene	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
n-Propylbenzene	EPA 8260B/624	EPA 8260B
o-Xylene	EPA 8260B/624	EPA 8260B
Pentachloroethane	EPA 8260B/624	EPA 8260B
p-Isopropyltoluene	EPA 8260B/624	EPA 8260B
Propionitrile (Ethyl cyanide)	EPA 8260B/624	EPA 8260B
sec-Butylbenzene	EPA 8260B/624	EPA 8260B
Styrene	EPA 8260B/624	EPA 8260B
tert-Butylbenzene	EPA 8260B/624	EPA 8260B
Tetrachloroethene (Perchloroethylene)	EPA 8260B/624	EPA 8260B
Toluene	EPA 8260B/624	EPA 8260B
trans-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B/624	EPA 8260B
Trichloroethene (Trichloroethylene)	EPA 8260B/624	EPA 8260B
Trichlorofluoromethane	EPA 8260B/624	EPA 8260B
Vinyl acetate	EPA 8260B/624	EPA 8260B
Vinyl chloride	EPA 8260B/624	EPA 8260B
Xylene (total)	EPA 8260B/624	EPA 8260B
Pesticides-Herbicides-PCBs		
2,4,5-T	EPA 8151A /615	EPA 8151A
2,4-D	EPA 8151A /615	EPA 8151A
2,4-DB	EPA 8151A /615	EPA 8151A
3,5-Dichlorobenzoic acid	EPA 8151A /615	EPA 8151A
4.4'-DDD	EPA 8081B/608	EPA 8081B
4.4'-DDE	EPA 8081B/608	EPA 8081B
4,4'·DDT	EPA 8081B/608	EPA 8081B
4-Nitrophenol	EPA 8151A/615	EPA 8151A
Acifiuorfen	EPA 8151A/615	EPA 8151A
Aldrin	EPA 8081B/608	EPA 8081B
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
alpha-Chlordane	EPA 8081B/608	EPA 8081B
Aroclor-1016(PCB-1016)	EPA 8082A/608	EPA 8082A
Aroclor-1221 (PCB-1221)	EPA 8082A/608	EPA 8082A
Aroclor-1232 (PCB-1232)	EPA 8082A/608	EPA 8082A
Aroclor-1242 (PCB-1242)	EPA 8082A/608	EPA 8082A
Aroclor-1248 (PCB-1248)	EPA 8082A/608	EPA 8082A
Aroclor-1254 (PCB-1254)	EPA 8082A/608	EPA 8082A
Aroclor-1260 (PCB-1260)	EPA 8082A/608	EPA 8082A
Azinphos-methyl (Guthion)	EPA 8141B/614	EPA 8141B
Bentazon	EPA 8151A/615	EPA 8151A
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
Bolstar (Sulprofos)	EPA 8141B/614	EPA 8141B
Chloramben	EPA 8151A/615	EPA 8151A
Chlordane (tech.)	EPA 8081B/608	EPA 8081B
Chlorpynfos	EPA 8141B/614	EPA 8141B
Coumaphos	EPA 8141B/614	EPA 8141B
Dacthal (DCPA)	EPA 8151A/615	EPA 8151A
Dalapon	EPA 8151A/615	EPA 8151A

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
delta-BHC	EPA 8081B/608	EPA 8081B
Demeton-o	EPA 8141B/614	EPA 8141B
Demeton-s	EPA 8141B/614	EPA 8141B
Diazinon	EPA 8141B/614	EPA 8141B
Dicamba	EPA 8151A/615	EPA 8151A
Dichlorofenthion	EPA 8141B/614	EPA 8141B
Dichloroprop (Dichlorprop)	EPA 8151A/615	EPA 8151A
Dlchlorovos (DDVP, Dichtorvos)	EPA 8141B/614	EPA 8141B
Dieldrin	EPA 8081B/608	EPA 8081B
Dimethoate	EPA 8141B/614	EPA 8141B
Dinoseb (2-sec-buty1-4 ,6-dinilrophenol, DNB P)	EPA 8151A/615	EPA 8151A
Disulfoton	EPA 8141B/614	EPA 8141B
Endosulfan I	EPA 8081B/608	EPA 8081B
Endosulfan II	EPA 8081B/608	EPA 8081B
Endosulfan sulfate	EPA 8081B/608	EPA 8081B
Endrin	EPA 8081B/608	EPA 8081B
Endrin aldehyde	EPA 8081B/608	EPA 8081B
Endrin ketone	EPA 8081B/608	EPA 8081B
EPN	EPA 8141B/614	EPA 8141B
Ethion	EPA 8141B/614	EPA 8141B
Ethoprop	EPA 8141B/614	EPA 8141B
fensulfothion	EPA 8141B/614	EPA 8141B
fenthion	EPA 8141B/614	EPA 8141B
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
gamma-Chlordane	EPA 8081B/608	EPA 8081B
Heptachlor	EPA 8081B/608	EPA 8081B
Heptachlor epoxide	EPA 8081B/608	EPA 8081B
Isodrin	EPA 8081B/608	EPA 8081B
Malathion	EPA 8141B/614	EPA 8141B
MCPA	EPA 8151A/615	EPA 8151A
Merphos	EPA 8141B/614	EPA 8141B
Methoxychlor	EPA 8081B/608	EPA 8081B
Methyl parathion (Parathion. methyl)	EPA 8141B/614	EPA 8141B
Mevinphos	EPA 8141B/614	EPA 8141B
Mirex	EPA 8081B/608	EPA 8081B
Monocrotophos	EPA 8141B/614	EPA 8141B
Naled	EPA 8141B/614	EPA 8141B
Parathion, ethyl	EPA 8141B/614	EPA 8141B
Pentachlorophenol	EPA 8151A/615	EPA 8151A
Phorate	EPA 8141B/614	EPA 8141B
Picloram	EPA 8151A/615	EPA 8151A
Ronnel	EPA 8141B/614	EPA 8141B
Silvex (2A.5-TP)	EPA 8151B/615	EPA 8151B
Stirofos	EPA 8141B/614	EPA 8141B
Sulfotepp	EPA 8141B/614	EPA 8141B
Tetraethyl pyrophosphate (TEPP)	EPA 8141B/614	EPA 8141B
Tokuthion (Prothiophos)	EPA 8141B/614	EPA 8141B
Toxaphene (Chlorinated camphene)	EPA 8081B/608	EPA 8081B
Trichloronate	EPA 8141B/614	EPA 8141B

Preparation Methods

Fraction	Analytical Method	Preparation Method
Cyanide	EPA 9014 EPA 335.2 /SM 4500-CN E	EPA 9010C
TX	EPA 9056A	EPA 5050
Metal water prep	EPA 6020A/200.8	EPA 3005A
Metals soil prep	EPA 6020A	EPA 3050B
Metals TCLP prep	EPA 6020A/200.8	EPA 3010A
Extractable organics and Pesticides water prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B/ 614	EPA 3510C
Extractable organics and Pesticides waste prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B/ 614	EPA 3580A
Extractable organics and Pesticides soil prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B/ 614	EPA 3550C
Organics water and mid-level soil prep	EPA 8260B/624	EPA 5030B
Organics low-level soil prep	EPA 8260B/624	EPA 5035
Soil/water leachate	Wets	ENCO WETS-88
SPLP	Wets, Organics, and Metals	EPA 1312
TCLP	Wets, Organics, and Metals	EPA 1311

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

GEL LABORATORIES, LLC

Charleston, SC

for technical competence in the field of

Environmental Testing

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

Presented this 23rd day of October 2009.

President & CEO
For the Accreditation Council
Certificate Number 2567.01
Valid to June 30, 2011

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

GEL LABORATORIES, LLC
2040 Savage Road
Charleston, SC 29414
Robert L. Pullano Phone: (843) 556-8171
rlp@gel.com

ENVIRONMENTAL

Valid To: June 30, 2011 Certificate Number: 2567.01

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

	Preparation SOP	Analytical SOP
Alpha Spectrometry: Alpha: Am-241, Am-243, Cf-252, Cm-242, Cm-243/244, Cm-245/246, Np-237, Po-208, Po-209, Po-210, Pu-236, Pu-238, Pu-239/240, Pu-242, Pu-244, Th-228, Th-229, Th-230, Th-232, U-232, U-233/234, U-235/236, U-238	GL-RAD-A-011, GL-RAD-A-016, GL-RAD-A-032, GL-RAD-A-036, GL-RAD-A-038, GL-RAD-A-043, GL-RAD-A-045	GL-RAD-I-009
Radon Emanation: Ra-226	GL-RAD-A-008, GL-RAD-A-028	GL-RAD-I-007
Gamma Spectrometry: Gamma: 46 to 1836 keV, I-129, I-131, Ni-59	GL-RAD-A-006, GL-RAD-A-013, GL-RAD-A-022	GL-RAD-I-001

Peter Mhyer

	Preparation SOP	Analytical SOP
Kinetic Phosphorescence Analyzer Total Uranium	GL-RAD-A-023	GL-RAD-B-018
Gas Flow Proportional Counting: Beta: Cl-36, I-131, Pb-210, Ra-228, Sr-89, Sr-90, Total Radium	GL-RAD-A-004, GL-RAD-A-009, GL-RAD-A-010, GL-RAD-A-017, GL-RAD-A-018, GL-RAD-A-029, GL-RAD-A-030, GL-RAD-A-033	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
Gross Alpha/Gross Beta:	GL-RAD-A-001, GL-RAD-A-001B, GL-RAD-A-001C	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
48 hour Gross Alpha	GL-RAD-A-047	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
Liquid Scintillation Spectrometry: Beta: C-14, Ca-45, Fe-55, H-3, Ni-63, P-32, Pm-147, Pu-241, S-35, Se-79, Tc-99 Alpha: Rn-222	GL-RAD-A-002, GL-RAD-A-003, GL-RAD-A-005, GL-RAD-A-007, GL-RAD-A-019, GL-RAD-A-020, GL-RAD-A-022, GL-RAD-A-031, GL-RAD-A-035, GL-RAD-A-040, GL-RAD-A-048, GL-RAD-A-049, GL-RAD-A-050	GL-RAD-I-004, GL-RAD-I-014, GL-RAD-I-017
ICP-MS Uranium Isotopes Tc-99	 GL-MA-E-008 GL-RAD-A-005	 GL-MA-E-014 GL-RAD-B-034

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

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Methylene Blue Active Substances, Misc.- Electronic Probes (pH, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), IR Spectrometry, Titrimetry, Total Organic Carbon, Total Organic Halide, Turbidity, Liquid Chromatography/Mass Spectrometer/Mass Spectrometer and Various Radiochemistry Techniques

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Metals		
Aluminum	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Antimony	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Arsenic	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Barium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Beryllium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Boron	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cadmium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Calcium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Chromium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cobalt	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Copper	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Iron	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lead	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lithium	EPA 6020/6020A	EPA 6020/6020A
Magnesium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Manganese	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Mercury	EPA 1631E/7470/7470A/245.1	EPA 7470/7470A/7471A/7471B
Molybdenum	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Nickel	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Phosphorous	EPA 6020/6020A	EPA 6010B/6010C/6020/6020A
Potassium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Selenium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Silicon[1]	EPA 6010B/6010C modified	EPA 6010B/6010C modified
Silica as SiO2	EPA 6010B/6010C	EPA 6010B/6010C
Silver	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Sodium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Strontium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Thallium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tin	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Titanium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tungsten	----------	EPA 6020/6020A
Vanadium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Zinc	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
General Chemistry		
Acidity	SM 2310 B/EPA 305.1	----------
Adsorbable Organic Halogens (AOX)	EPA 1650	----------
Alkalinity	SM 2320B/EPA 310.1	----------

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Ammenable Cyanide	EPA 9012A/9012B/EPA 335.1	EPA 9012A/9012B
Ammonia Nitrogen	EPA 350.1	----------
Biochemical oxygen demand	SM 5210 B/EPA 405.1	----------
Bromide	EPA 9056A/EPA 300.0	EPA 9056A[3]
Carbonaceous BOD	SM 5210 B	----------
Chemical Oxygen Demand (COD)	EPA 410.4	----------
Chloride	EPA 9056A/EPA 300.0	EPA 9056A[3]
Chlorine (residual)	SM 4500Cl-G/EPA 330.5	----------
Chromium VI	EPA 7196A/SM 3500Cr-B	EPA 7196A
Color	SM 2120B/EPA 110.2	----------
Corrosivity toward Steel	----------	EPA 1110/1110A
Cyanide	EPA 9012A/9012B/335.3/335.4	EPA 9012A/9012B
Density	----------	ASTM D 5057
Extractable Organic Halides (EOX)	----------	EPA 9023
Filterable residue	SM 2540C	----------
Fluoride	EPA 9056A/EPA 300.0	EPA 9056A[3]
Ignitability	EPA 1010/1020A/1020B	EPA 1010/1020A/1020B
Hardness	SM 2340B/SM2340C/ EPA 130.2	----------
Kjeldahl Nitrogen	EPA 351.2	----------
MBAS/Surfactants	SM 5540C/EPA 425.1	----------
Moisture Determination	----------	ASTM D-2216 (M)
Nitrate (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Nitrate-nitrite (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Nitrite (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Nonfilterable residue	SM 2540D	----------
Oil & Grease	EPA 1664A	EPA 1664A
Organic Nitrogen	TKN – Ammonia EPA 351.2 – EPA 350.1	----------
Orthophosphate (as P)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Paint Filter Liquids Test	----------	EPA 9095A/9095B
Perchlorate	EPA 314.0/6850	EPA 6850
pH	SM 4500-H^+ B/ EPA 9040B /9040C/9041A/ EPA 150.1	EPA 9040B/9040C/9045C/9045D
Reactive Cyanide	Sec 7.3.3 SW846	Sec 7.3.3 SW846
Reactive Sulfide	Sec 7.3.4 SW846	Sec 7.3.4 SW846
Residue-Volatile	SM 2540E/EPA 160.4	----------
Residue-Settleable	SM 2540F	----------
Specific conductance	EPA 9050A/EPA 120.1	----------
Sulfate	EPA 9056A/EPA 300.0	EPA 9056A[3]
Sulfite	SM 4500-SO3 B	----------
Sulfide	EPA 9030B/9034	EPA 9030B/9034
Temperature	EPA 170.1	EPA 170.1
Total, fixed, and volatile residue	SM 2540G	----------
Total Nitrate-Nitrite	EPA 353.2	----------
Total Organic Carbon (TOC)	EPA 9060/9060A/ SM 5310D/415.1	EPA 9060/9060A[2]

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Total Organic Halides (TOX)	EPA 9020B	EPA 9020B[2]
Total Petroleum Hydrocarbons	EPA 1664A	EPA 1664A
Total Phenolics	EPA 9066/EPA 420.4	----------
Total Phosphorous	EPA 365.4	----------
Total residue	SM 2540B	----------
Turbidity	EPA 180.1/SM 2130	EPA 180.1/SM 2130
Organic Analytes		
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011/8260B	EPA 8260B
1,2 Dibromoethane (EDB)	EPA 8011/8260B	EPA 8260B
Purgeable Organics (Volatiles)		
Acetone	EPA 8260B	EPA 8260B
Acetonitrile	EPA 8260B	EPA 8260B
Acrolein (Propenal)	EPA 8260B	EPA 8260B
Acrylonitrile	EPA 8260B	EPA 8260B
Allyl Chloride	EPA 8260B	EPA 8260B
Benzene	EPA 8260B	EPA 8260B
Benzyl chloride	EPA 8260B	EPA 8260B
Bromobenzene	EPA 8260B	EPA 8260B
Bromochloromethane	EPA 8260B	EPA 8260B
Bromodichloromethane	EPA 8260B	EPA 8260B
Bromoform	EPA 8260B	EPA 8260B
Bromomethane	EPA 8260B	EPA 8260B
2-Butanone (Methyl Ethyl Ketone)	EPA 8015B/8015C/8260B	EPA 8260B
n-Butyl alcohol	EPA 8015B/8015C/8260B	EPA 8260B
n-Butylbenzene	EPA 8260B	EPA 8260B
Sec-Butylbenzene	EPA 8260B	EPA 8260B
Tert-Butylbenzene	EPA 8260B	EPA 8260B
Carbon disulfide	EPA 8260B	EPA 8260B
Carbon tetrachloride	EPA 8260B	EPA 8260B
Chlorobenzene	EPA 8260B	EPA 8260B
Chloroethane	EPA 8260B	EPA 8260B
2-Chloroethyl vinyl ether	EPA 8260B	EPA 8260B
Chloroform	EPA 8260B	EPA 8260B
Chloromethane	EPA 8260B	EPA 8260B
Chloroprene	EPA 8260B	EPA 8260B
2-Chlorotoluene	EPA 8260B	EPA 8260B
4-Chlorotoluene	EPA 8260B	EPA 8260B
Dibromochloromethane	EPA 8260B	EPA 8260B
Dibromomethane	EPA 8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
1,3-Dichlorobenzene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
1,4-Dichlorobenzene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
Dichlorodifluoromethane	EPA 8260B	EPA 8260B
1,1-Dichloroethane	EPA 8260B	EPA 8260B
1,2-Dichloroethane	EPA 8260B	EPA 8260B
1,1-Dichloroethene	EPA 8260B	EPA 8260B
cis-1,2-Dichloroethene	EPA 8260B	EPA 8260B

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
trans-1,2-Dichloroethene	EPA 8260B	EPA 8260B
1,2-Dichloropropane	EPA 8260B	EPA 8260B
1,3-Dichloropropane	EPA 8260B	EPA 8260B
2,2-Dichloropropane	EPA 8260B	EPA 8260B
1,1-Dichloropropene	EPA 8260B	EPA 8260B
cis-1,3-Dichloropropene	EPA 8260B	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B	EPA 8260B
cis-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B
Diethyl ether	EPA 8260B	EPA 8260B
1,4-Dioxane	EPA 8260B	EPA 8260B
Ethyl Acetate	EPA 8015B/8015C/8260B	EPA 8015B/8015C/8260B
Ethyl Benzene	EPA 8260B	EPA 8260B
Ethyl methacrylate	EPA 8260B	EPA 8260B
2-Hexanone	EPA 8260B	EPA 8260B
Hexachlorobutadiene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
Isopropylbenzene	EPA 8260B	EPA 8260B
4-Isopropyltoluene	EPA 8260B	EPA 8260B
Iodomethane	EPA 8260B	EPA 8260B
Isobutyl Alcohol	EPA 8015B/8015C/8260B	EPA 8260B
Methacrylonitrile	EPA 8260B	EPA 8260B
Methylene chloride	EPA 8260B	EPA 8260B
Methyl methyacrylate	EPA 8260B	EPA 8260B
4-Methyl-2-pentanone	EPA 8260B	EPA 8260B
Methyl tert butyl ether (MTBE)	EPA 8260B	EPA 8260B
Naphthalene	EPA 8260B/8270C/8270D/8310	EPA 8260B/8270C/8270D/8310
2-Nitropropane	EPA 8260B	EPA 8260B
n-Propylbenzene	EPA 8260B	EPA 8260B
Pentachloroethane	EPA 8260B	EPA 8260B
Propionitrile	EPA 8260B	EPA 8260B
Styrene	EPA 8260B	EPA 8260B
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B	EPA 8260B
Tetrachloroethene	EPA 8260B	EPA 8260B
Toluene	EPA 8260B	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B	EPA 8260B
Trichloroethene	EPA 8260B	EPA 8260B
Trichlorofluoromethane	EPA 8260B	EPA 8260B
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	----------
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B
Trihalomethanes	EPA 8260B	EPA 8260B
Vinyl acetate	EPA 8260B	EPA 8260B
Vinyl chloride	EPA 8260B	EPA 8260B
Xylenes, total	EPA 8260B	EPA 8260B
o-Xylene	EPA 8260B	EPA 8260B

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
m+p-Xylene	EPA 8260B	EPA 8260B
Semivolatile Compounds		
Acenaphthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Acenaphthylene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Acetophenone	EPA 8270C/8270D	EPA 8270C/8270D
2-Acetylaminofluorene	EPA 8270C/8270D	EPA 8270C/8270D
4-Aminobiphenyl	EPA 8270C/8270D	EPA 8270C/8270D
Aniline	EPA 8270C/8270D	EPA 8270C/8270D
Anthracene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Aramite	EPA 8270C/8270D	EPA 8270C/8270D
Atrazine	EPA 8270C/8270D	EPA 8270C/8270D
Benzidine	EPA 8270C/8270D	EPA 8270C/8270D
Benzoic acid	EPA 8270C/8270D	EPA 8270C/8270D
Benzo (a) anthracene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (b) fluoranthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (k) fluoranthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (ghi) perylene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (a) pyrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
p-Benzoquinone	EPA 8270C/8270D	EPA 8270C/8270D
Benzyl alcohol	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-chloroethoxy) methane	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-chloroethyl) ether	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-chloroisopropyl) ether	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-ethylhexyl) phthalate	EPA 8270C/8270D	EPA 8270C/8270D
4-Bromophenyl phenyl ether	EPA 8270C/8270D	EPA 8270C/8270D
Butyl benzyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Carbazole	EPA 8270C/8270D	EPA 8270C/8270D
4-Chloroaniline	EPA 8270C/8270D	EPA 8270C/8270D
Chlorobenzilate	EPA 8270C/8270D	EPA 8270C/8270D
4-Chloro-3-methylphenol	EPA 8270C/8270D	EPA 8270C/8270D
2-Chloronaphthalene	EPA 8270C/8270D	EPA 8270C/8270D
2-Chlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
4-Chlorophenyl phenyl ether	EPA 8270C/8270D	EPA 8270C/8270D
Chrysene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
n-Decane	EPA 625	----------
Diallate	EPA 8270C/8270D	EPA 8270C/8270D
Dibenzo (a,h) anthracene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Dibenzofuran	EPA 8270C/8270D	EPA 8270C/8270D
Dibenzo (a,e) pyrene	EPA 8270C/8270D	EPA 8270C/8270D
1,2-Dichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
1,3-Dichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
1,4-Dichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
3,3'-Dichlorobenzidine	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
2,6-Dichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
3,3'-Dimethylbenzidine	EPA 8270C/8270D	EPA 8270C/8270D
Diethyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Dimethoate	EPA 8270C/8270D	EPA 8270C/8270D
1,3-Dinitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
1,4-Dinitrobenzene	EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Disulfoton	EPA 8270C/8270D	EPA 8270C/8270D
p-Dimethylaminoazobenzene	EPA 8270C/8270D	EPA 8270C/8270D
7,12-Dimethylbenz(a)anthracene	EPA 8270C/8270D	EPA 8270C/8270D
Alpha-,alpha-Dimethylphenethylamine	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dimethylphenol	EPA 8270C/8270D	EPA 8270C/8270D
Dimethyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Di-n-butyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Di-n-octyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrotoluene	EPA 8270/8330/8330B	EPA 8270/8330/8330B
2,6-Dinitrotoluene	EPA 8270/8330/8330B	EPA 8270/8330/8330B
Diphenylamine	EPA 8270C/8270D	EPA 8270C/8270D
1,2-Diphenylhydrazine	EPA 8270C/8270D	EPA 8270C/8270D
Ethyl methanesulfonate	EPA 8270C/8270D	EPA 8270C/8270D
Famphur	EPA 8270C/8270D	EPA 8270C/8270D
Fluoroanthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Fluorene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Hexachlorobenzene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorobutadiene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
Hexachlorophene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachloropropene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorocyclopentadiene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachloroethane	EPA 8270C/8270D	EPA 8270C/8270D
Indeno (1,2,3-cd) pyrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Isodrin	EPA 8270C/8270D	EPA 8270C/8270D
Isophorone	EPA 8270C/8270D	EPA 8270C/8270D
Isosafrole	EPA 8270C/8270D	EPA 8270C/8270D
Kepone	EPA 8270C/8270D	EPA 8270C/8270D
Methapyrilene	EPA 8270C/8270D	EPA 8270C/8270D
3-Methylcholanthrene	EPA 8270C/8270D	EPA 8270C/8270D
2-Methyl-4,6-Dinitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
Methyl methanesulfonate	EPA 8270C/8270D	EPA 8270C/8270D
1-Methylnaphthalene	EPA 8270C/8270D	EPA 8270C/8270D
2-Methylnaphthalene	EPA 8270C/8270D	EPA 8270C/8270D
Methyl Parathion	EPA 8270C/8270D	EPA 8270C/8270D
2-Methylphenol (o-cresol)	EPA 8270C/8270D	EPA 8270C/8270D
3/4-Methylphenols(m/p cresols)	EPA 8270C/8270D	EPA 8270C/8270D
Naphthalene	EPA 8260B/8270C/8270D/8310	EPA8260B/8270C/8270D/8310
1,4-Naphthoquinone	EPA 8270C/8270D	----------
1-Naphthylamine	EPA 8270C/8270D	EPA 8270C/8270D
2-Naphthylamine	EPA 8270C/8270D	EPA 8270C/8270D
2-Nitroaniline	EPA 8270C/8270D	EPA 8270C/8270D
3-Nitroaniline	EPA 8270C/8270D	EPA 8270C/8270D
4-Nitroaniline	EPA 8270C/8270D	EPA 8270C/8270D
Nitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
5-Nitro-o-toluidine	EPA 8270C/8270D	EPA 8270C/8270D
2-Nitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
4-Nitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
Nitroquinoline-1-oxide	EPA 8270C/8270D	EPA 8270C/8270D

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Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
N-Nitrosodietheylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodimethylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-butylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-propylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodiphenylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodimethylethylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosomorpholine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosopiperidine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosopyrrolidine	EPA 8270C/8270D	EPA 8270C/8270D
n-Octadecane	----------	EPA 8270C/8270D
o,o,o-Triethyl phosphorothioate	EPA 8270C/8270D	EPA 8270C/8270D
o-Toluidine	EPA 8270C/8270D	EPA 8270C/8270D
Parathion, ethyl	EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorobenzene	EPA 8270C/8270D	EPA 8270C/8270D
Pentachloronitrobenzene	EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorophenol	EPA 8270C/8270D/8151A	EPA 8270C/8270D/8151A
Phenacetin	EPA 8270C/8270D	EPA 8270C/8270D
Phenanthrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Phenol	EPA 8270C/8270D	EPA 8270C/8270D
1,4-Phenylenediamine	EPA 8270C/8270D	----------
Phorate	EPA 8270C/8270D	EPA 8270C/8270D
2-Picoline (2-Methylpyridine)	EPA 8270C/8270D	EPA 8270C/8270D
Pronamide (Kerb)	EPA 8270C/8270D	EPA 8270C/8270D
Pyrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Pyridine	EPA 8270C/8270D	EPA 8270C/8270D
Safrole	EPA 8270C/8270D	EPA 8270C/8270D
Sulfotepp	EPA 8270C/8270D	EPA 8270C/8270D
1,2,4,5-Tetrachlorobenzene	EPA 8270C/8270D	EPA 8270C/8270D
2,3,4,6-Tetrachlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
Thionazin (Zinophos)	EPA 8270C/8270D	EPA 8270C/8270D
1,2,4-Trichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
2,4,5-Trichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
2,4,6-Trichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
1,3,5-Trinitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
Pesticides & PCBs		
Aldrin	EPA 8081A/8081B	EPA 8081A/8081B
alpha-BHC	EPA 8081A/8081B	EPA 8081A/8081B
alpha-Chlordane	EPA 8081A/8081B	EPA 8081A/8081B
beta-BHC	EPA 8081A/8081B	EPA 8081A/8081B
Chlordane (technical)	EPA 8081A/8081B	EPA 8081A/8081B
delta-BHC	EPA 8081A/8081B	EPA 8081A/8081B
gamma-BHC	EPA 8081A/8081B	EPA 8081A/8081B
gamma-Chlordane	EPA 8081A/8081B	EPA 8081A/8081B
4,4’-DDD	EPA 8081A/8081B	EPA 8081A/8081B
4,4’-DDE	EPA 8081A/8081B	EPA 8081A/8081B
4,4’,-DDT	EPA 8081A/8081B	EPA 8081A/8081B
Dieldrin	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan I	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan II	EPA 8081A/8081B	EPA 8081A/8081B

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Endonsulfan sulfate	EPA 8081A/8081B	EPA 8081A/8081B
Endrin	EPA 8081A/8081B	EPA 8081A/8081B
Endrin aldehyde	EPA 8081A/8081B	EPA 8081A/8081B
Endrin ketone	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor epoxide	EPA 8081A/8081B	EPA 8081A/8081B
Methoxychlor	EPA 8081A/8081B	EPA 8081A/8081B
Toxaphene	EPA 8081A/8081B	EPA 8081A/8081B
PCB-1016 (Aroclor)	EPA 8082/8082A	EPA 8082/8082A
PCB-1221	EPA 8082/8082A	EPA 8082/8082A
PCB-1232	EPA 8082/8082A	EPA 8082/8082A
PCB-1242	EPA 8082/8082A	EPA 8082/8082A
PCB-1248	EPA 8082/8082A	EPA 8082/8082A
PCB-1254	EPA 8082/8082A	EPA 8082/8082A
PCB-1260	EPA 8082/8082A	EPA 8082/8082A
PCB-1262	EPA 8082/8082A	EPA 8082/8082A
PCB-1268	EPA 8082/8082A	EPA 8082/8082A
Total Aroclors	EPA 8082/8082A	EPA 8082/8082A
FID Compounds		
Ethyl acetate	EPA 8015B/8015C/8260B	EPA 8015B/8015C/8260B
Ethylene Glycol	EPA 8015B/8015C	EPA 8015B/8015C
Isobutyl Alcohol	EPA 8015B/8015C/8260B	EPA 8260B
Isopropyl Alcohol (2-Propanol)	EPA 8015B/8015C	----------
Methanol	EPA 8015B/8015C	EPA 8015B/8015C
Diesel Range Organics (DRO)	EPA 8015B/8015C/CA-LUFT/ CT-ETPH	EPA 8015B/8015C/CA-LUFT/ CT-ETPH
Gas Range Organics (GRO)	EPA 8015B/8015C/CA-LUFT	EPA 8015B/8015C/CA-LUFT
Herbicides		
2,4-D	EPA 8151A	EPA 8151A
2,4-DB	EPA 8151A	EPA 8151A
Dalapon	EPA 8151A	EPA 8151A
Dicamba	EPA 8151A	EPA 8151A
Dichloroprop	EPA 8151A	EPA 8151A
Dinoseb	EPA 8151A	EPA 8151A
MCPA	EPA 8151A	EPA 8151A
MCPP	EPA 8151A	EPA 8151A
2,4,5-T	EPA 8151A	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A	EPA 8151A
Pentachlorophenol	EPA 8151A	EPA 8151A
Nitrosamines, Nitroaromatics		
1,3-Dinitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
2,4-Dinitrotoluene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
2,6-Dinitrotoluene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
2,4,6-Trinitrotoluene	EPA 8330/8330B	EPA 8330/8330B
2-Amino-4,6-Dinitrotoluene	EPA 8330/8330B	EPA 8330/8330B
2-Nitrotoluene	EPA 8330/8330B	EPA 8330/8330B
3-Nitrotoluene	EPA 8330/8330B	EPA 8330/8330B
4-Amino-2,6-Dinitrotoluene	EPA 8330/8330B	EPA 8330/8330B

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
4-Nitrotoluene	EPA 8330/8330B	EPA 8330/8330B
Nitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
Nitroglycerine	EPA 8330/8330B	EPA 8330/8330B
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330/8330B	EPA 8330/8330B
Pentaerythritoltetranitrate (PETN)	EPA 8330/8330B	EPA 8330/8330B
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	EPA 8330/8330B	EPA 8330/8330B
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330/8330B	EPA 8330/8330B
Radiochemistry		
Barium 133	DOE 4.5.2.3	DOE 4.5.2.3
Cesium 134	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Cesium 137	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Cobalt-60	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Gamma Emitters	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Gross Alpha	EPA 900.0/9310	EPA 9310
Gross Beta	EPA 900.0/9310	EPA 9310
Radioactive Iodine	DOE 4.5.2.3/EPA 901.1/902.0	DOE 4.5.2.3
Radium-226	EPA 903.1/DOE Ra-04	DOE Ra-04
Radium-228	EPA 904.0/9320/DOE 4.5.2.3	DOE 4.5.2.3/EPA9320
Total Radium	EPA 9315	EPA 9315
Radon	SM7500 Rn-B	----------
Strontium-89	EPA 905.0	DOE Sr-01
Strontium-90	EPA 905.0/DOE Sr-02	DOE Sr-02
Thorium	DOE 4.5.5	DOE 4.5.5
Tritium	EPA 906.0	----------
Uranium	ASTM D5174-02/D5174-97/DOE U-02/EPA 6020/6020A	DOE U-02/EPA 6020/6020A
Zinc-65	EPA 901.1/DOE 4.5.2.3	DOE 4.5.2.3
Preparatory and Clean-up Methods		
Toxicity Characteristic Leaching Procedure (Inorganics, Extractable Organics, Volatile Organics)	----------	EPA 1311
Synthetic Preparation Leaching Procedure	----------	EPA 1312
Waste Extraction Test (W.E.T.)	----------	CCR Chapter 11, Article 5, Appendix II
Anion Preparation	----------	EPA 9056A[3]
Cyanide Distillation	EPA 9010B/9010C	EPA 9010B/9010C[3]
Sulfide Distillation	EPA 9030B	EPA 9030B
Metals Digestion	EPA 200.2, 3005A, 3010A	EPA 3050B
Alkaline Digestion for Hexavalent Chromium	----------	EPA 3060A
Bomb Preparation for Solid Waste	----------	EPA 5050

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Mercury Preparation	EPA 7470/7470A	EPA 7471A/7471B
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	----------
Continuous Liquid-Liquid Extraction	EPA 3520C	----------
Solid Phase Extraction	EPA 3535A	----------
Automated Soxhlet Extraction	----------	EPA 3541
Ultrasonic Extraction	----------	EPA 3550C
Waste Dilution	----------	EPA 3580A
Waste Dilution for Volatile Organics	----------	EPA 3585
Purge and Trap for Volatile Organics	EPA 5030A/5030B/5030C	EPA 5035/5035A
Alumina Clean-up	----------	EPA 3610B/3611B
Florisil Clean-up	----------	EPA 3620B/3620C
Silica Gel Clean-up	----------	EPA 3630C
Gel Permeation Clean-up	----------	EPA 3640A
Sulfur Clean-up	----------	EPA 3660B
Sulfuric Acid/Permanganate Clean-up	----------	EPA 3665A

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

	Preparation SOP	Analytical SOP
Bioassy Analysis		
Alpha Spectrometry: Alpha: Am-241, Cm-242, Cm-243/244, Cm 245/246,Cf-252, Np-237, Po-208, Po- 209, Po-210, Pu-236, Pu-238, Pu-239/240, Pu-242, Pu-244, Th-228, Th-229, Th-230, Th-232, U-232, U-233/234, U-235/236, U-238	GL-RAD-B-001, GL-RAD-B-002, GL-RAD-B-003, GL-RAD-B-010, GL-RAD-B-012, GL-RAD-B-013, GL-RAD-B-017	GL-RAD-B-009
Liquid Scintillation Spectrometry: C-14, Gross Alpha, H-3, Ni-63, Pu-241, Tc-99	GL-RAD-B-001, GL-RAD-B-008, GL-RAD-B-011, GL-RAD-B-012, GL-RAD-B-013, GL-RAD-B-016, GL-RAD-B-020, GL-RAD-B-023	GL-RAD-I-004, GL-RAD-I-014, GL-RAD-I-017
Gas Flow Proportional Counting: Beta: Sr-90	GL-RAD-B-001	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016

	Preparation SOP	Analytical SOP
Bioassy Analysis		
Gross Alpha/Gross Beta:	GL-RAD-B-022	GL-RAD-I-006
Kinetic Phosphorescence Analyzer Total Uranium	GL-RAD-B-019	GL-RAD-B-018
Radon Emanation: Ra-226	GL-RAD-B-002	GL-RAD-I-007
Refractometer Specific Gravity	GL-RAD-B-027	GL-RAD-B-027
ICP-MS Uranium Isotopes	GL-RAD-B-035	GL-RAD-B-027
Gamma Spectrometry: Gamma: Ni-59, 46 to 1836 keV	GL-RAD-B-020, GL-RAD-A-013	GL-RAD-I-001

Finally, accreditation is also granted to this laboratory to perform the following tests on children's toys:

Chemical	
Lead in Paint by ICP	16 CFR part 1303 (using GL-MA-E-009 and GL-MA-E-013)

1 - Calculated from silica determination

2 – Applicable only to liquid 'Solid Hazardous Waste', where liquids may include aqueous, non-aqueous, and oily wastes. Solids may include soils, sediments, sludges, tissues, filters and any matrix deemed non-liquid.

3 – The referenced method is modified to include a simple prep for non-aqueous and/or solid matrix samples.

Appendix C
UFP-SAP Cross Walk Table and QAPP

Final

Quality Assurance Project Plan

Intrusive Investigation for Military Munitions Response Program Sites: UXO-01 - Former Live Hand Grenade Course (ASR # 2.23), UXO-01 - Former Gas Chamber (ASR # 2.79a, b, c), UXO-07 – Former Practice Hand Grenade Course (ASR # 2.77a and #2.77b), and UXO-21 - Former D-Area Gas Chamber (2D MAR DIV) (ASR # 2.204)

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order WE41

September 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

Charlotte, North Carolina

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Acronyms and Abbreviations

BIP	blow-in-place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
CompQAP	Comprehensive Quality Assurance Plan
CTO	Contract Task Order
DL	detection limit
DoD	Department of Defense
DQE	data quality evaluation
DQO	data quality objective
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ENCO	Environmental Conservation Laboratories
FSP	Field Sampling Plan
IDW	investigation-derived waste
LOD	limit of detection
LOQ	limit of quantitation
M&TE	measuring and test equipment
MC	munitions constituents
MCB CamLej	Marine Corp Base Camp Lejeune
MEC	munitions and explosives of concern
MPP	Master Project Plans
MPPEH	material potentially presenting an explosive hazard
MMRP	Military Munitions Response Program
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NC SSL	North Carolina Soil Screening Level
NCDENR	North Carolina Department of Environment and Natural Resources
PA	Preliminary Assessment
PAL	project action limit
PARCC	Precision, Accuracy, Representativeness, Completeness, and Comparability
PC	Project Chemist
PETN	Pentaerithrityl Tetranitrate
PM	Project Manager
PQO	project quality objective

QA	quality assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QC	quality control
RPD	relative percent difference
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SI	Site Investigation
SOP	standard operating procedure
TAL	target analyte list
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance

Contents

Attachments

QAPP Identifying Information

Site Name/Number:	Marine Corps Base Camp Lejeune (MCB CamLej)
Operable Unit:	Not Applicable
Contractor Name:	CH2M HILL
Contract Number:	N62470-08-D-1000
Contract Title:	Naval Facilities Engineering Command (NAVFAC) Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000

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

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of:
   - *Uniform Federal Policy for Quality Assurance Project Plans* (USEPA, 2005)
   - *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5 QAMS* (USEPA, 2002)
   - Identify any additional guidance used to prepare SAP: None
2. Identify regulatory program:
   - Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
3. This Quality Assurance Project Plan (QAPP) is a project-specific QAPP.
4. List dates of scoping sessions that were held:
   - Formal scoping sessions were not used. This QAPP is for CERCLA and the criteria for the Focused Preliminary Assessment (PA)/Site Investigation (SI) had previously been agreed upon by the MCB CamLej Partnering Team.
5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.
   - *Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) for Preliminary Assessment/Site Inspection, Unexploded Ordnance (UXO) Sites UXO-02, UXO-07, UXO-10, UXO-11, and UXO-14* (CH2M HILL, 2009)
6. List organizational partners (stakeholders) and connection with lead organization:
   - MCB CamLej
   - United States Environmental Protection Agency (USEPA) Region IV
   - North Carolina Department of the Environment and Natural Resources (NCDENR)
7. Lead organization
   - NAVFAC Mid-Atlantic

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:

   – Worksheet #9 – Not applicable. Scope was issued by NAVFAC.

   – Worksheet #13 – Not applicable. No secondary data was used in developing this QAPP.

   – The crosswalk table below references the location of all 37 required elements of the Uniform Federal Policy (UFP)-SAP. They are either provided in the attached QAPP or in accompanying documents.

Crosswalk to Related Information

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
1.0 Introduction and Project Organization		
Documentation		
1	Title and Approval Page	Page 1
2	QAPP Identifying Information	Page 7
3	Distribution List	Table 1 of **Attachment 1**
4	Project Personnel Sign-off Sheet	Table 1 of **Attachment 1**
Project Organization		
5	Project Organizational Chart	Section 2.4 of Work Plan Addendum (CH2M HILL, 2011)
6	Communication Pathways	Table 1 of **Attachment 1**
7	Personnel Responsibilities and Qualifications Table	Table 1 of **Attachment 1**, and Table 2-1 of Work Plan Addendum (CH2M HILL, 2011)
8	Special Personnel Training Requirements Table	Section 1.7
Project Planning/ Problem Definition		
9	Project Scoping Session Participants Sheet	Not applicable
10	Problem Definition, Site History, and Background Site Maps (historical and present)	Section 1 of Work Plan Addendum (CH2M HILL, 2011)
11	Site-Specific Project Quality Objectives / Systematic Planning Process Statements	Section 1.6.4
12	Measurement Performance Criteria Table	Table 7A and 7B of **Attachment 1**
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	Not Applicable
14	Summary of Project Tasks	Figure 2-1 of Work Plan Addendum (CH2M HILL, 2011)
15	Reference Limits and Evaluation Table	Table 5A and 5B of **Attachment 1**
16	Project Schedule / Timeline Table	Figure 2-1 of Work Plan Addendum (CH2M HILL, 2011)
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	Section 3.4 of Work Plan Addendum (CH2M HILL, 2011)
18	Sampling Locations and Methods / Standard Operating Procedure (SOP) Requirements Table	Figures 9-1, 10-1, 12-1, and 16-1 of Work Plan Addendum (CH2M HILL, 2011) Section3.4 of Work Plan Addendum
19	Analytical SOP Requirements Table	Table 4 of **Attachment 1**
20	Field Quality Control Sample Summary Table	Table 3-2 of Work Plan Addendum

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
21	Project Sampling SOP References Table Sampling SOPs	Section 3.4 of Work Plan Addendum (CH2M HILL, 2011) Section 5.3 of MRP MPP (CH2M HILL, 2010)
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Section 2.7 and 2.8 Section 7 of Master QAPP (CH2M HILL, 2008)
Analytical Tasks		
23	Analytical SOP References Table	Table 2 of **Attachment 1**
24	Analytical Instrument Calibration Table	Table 9 of **Attachment 1**
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	Table 8 of **Attachment 1**
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	Section 2.3 of Master QAPP (CH2M HILL, 2008)
27	Sample Custody Requirements, Procedures/SOPs Example Chain-of-Custody Form and Seal	Section 3.4. of Work Plan Addendum (CH2M HILL, 2011) Section 6 of Master QAPP (CH2M HILL, 2008)
Quality Control Samples		
28	Laboratory QC Samples Table	Table 6A -6C of **Attachment 1**
Data Management Tasks		
29	Project Documents and Records Table	Section 6.7 of Master QAPP (CH2M HILL, 2008)
30	Analytical Services Table Analytical and Data Management SOPs	Table 3 of **Attachment 1**
C. Assessment Oversight		
31	Planned Project Assessments	Section 3
32	Assessment Findings and Corrective Action Responses Audit Checklists	Section 3 Table 10 of **Attachment 1**
33	Quality Assurance (QA) Management Reports	Section 3
D. Data Review		
34	Verification Process	Section 4.2.1
35	Validation Process	Section 4.2.2
36	Validation Summary	Section 4.2.2
37	Usability Assessment	Section 4.3

Quality Assurance Project Plan

1 Introduction and Project Organization

1.1 Introduction

This site-specific QAPP is meant to serve in conjunction with the MCB CamLej Master Project QAPP (CH2M HILL, 2008) and the MCB CamLej Military Munitions Response Program (MMRP) Master Project Plans (MPP) (CH2M HILL, 2010). The specific information contained in this site-specific QAPP supplements the general information contained in the Master QAPP. This document applies to investigative activities at Sites UXO-01 (ASR #2.23), UXO-01 (ASR #2.79a, b, and c), UXO-07, and UXO-21. The intrusive investigation will further evaluate the presence of impacted soil at MMRP Sites UXO-01 (ASR # 2.23), UXO-01 (ASR # 2.79a, b, c), UXO-07, and UXO-21. Investigative activities are defined in the *Site-Specific Work Plan Addendum for Military Munitions Response Program Sites: UXO-01 - Former Live Hand Grenade Course (ASR # 2.23), UXO-01 - Former Gas Chamber (ASR # 2.79a, b, c), UXO-02 - Former Unnamed Explosive Contaminated Range (ASR #2.201),UXO-07 – Former Practice Hand Grenade Course (ASR # 2.77a and #2.77b), UXO-14 - Former Indoor Pistol Range (ASR #2.199) and Former Gas Chamber (ASR #2.200), and UXO-21 - Former D-Area Gas Chamber (2D MAR DIV) (ASR # 2.204)* (Work Plan Addendum) (CH2M HILL, 2011).

This QAPP is a component of the Intrusive Investigation Work Plan Addendum (CH2M HILL, 2011) and has been prepared in accordance with the *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (USEPA, 2001). This QAPP describes the data quality objectives (DQOs), specific QA and quality control (QC) activities, and laboratory activities necessary to achieve the DQOs of the project. It also provides QA/QC requirements for sampling activities, sample analysis, and other tests that will generate data as part of the activities performed for the intrusive investigation. Subcontractors will be required to review both the Master QAPP and the site-specific QAPP. Subcontractors will be expected to adhere to the procedures specified in these documents. All field activities will be conducted by CH2M HILL.

The requirements of this document apply to contractors and subcontractors. Deviations from these procedures will be documented.

Section 1 provides an overview of project management and addresses the following topics:

- Project organization and roles and responsibilities
- Project definition and background
- Project description
- Quality objectives and criteria for measurement data
- Documentation and records management

1.2 Project Organization Roles and Responsibilities

Please refer to Table 1 of **Attachment 1** for the list of key team members for each project, the QA/QC responsibilities associated with each position, and a description of the communication procedures that will be followed throughout the specific project. The organizational structure and responsibilities are designed to provide project control and QA for the proposed monitoring.

1.3 Distribution List and Project Personnel Sign-off Sheet and Communication Pathways and Procedures

1.3.1 Project Communication

Effective communication among all project personnel will be established and maintained throughout the course of the project and is essential for effective implementation of field activities.

Attachment 1, Table 1, *Communication Pathway and Procedures, Distribution List, and Project Personnel Sign-Off Sheet,* provides the following information:

- Distribution list and Project Personnel Sign-off Sheet: A list of all recipients of the QAPP. This list is not exclusively for CH2M HILL personnel alone, and may include laboratory, driller, surveyor, and/or data validation subcontractor information. Returned signed copies of this table shall be kept in project files as documentation that project personnel have read the QAPP.
- Communication pathways and procedures for each specific project personnel.

1.3.2 Laboratory Work Group

The selected laboratory is responsible for analyzing samples collected during field activities, in accordance with the Field Sampling Plan (FSP) and the most current version of the *Department of Defense Quality Systems Manual for Environmental Laboratories* (DoD, 2009). The laboratory Project Manager (PM) or Client Service Manager acts as a liaison between laboratory and the Project Chemist (PC) and/or the field team.

1.4 Problem Definition and Background

This intrusive investigation is occurring to further investigate the presence and nature of munitions and explosives of concern (MEC) and material potentially presenting an explosive hazard (MPPEH) in the soil within MMRP Sites UXO-01 (ASR # 2.23), UXO-01 (ASR # 2.79a, b, c), UXO-07, and UXO-21.

Refer to Section 1 of the Work Plan Addendum (CH2M HILL, 2011) for the background of each site.

1.5 Project Description

The objectives of the intrusive investigation sampling effort are detailed in Section 1.2 of the Work Plan Addendum (CH2M HILL, 2011) and include the following:

- Conduct environmental sampling for munitions constituents (MC) at locations where controlled detonations are conducted
- Prepare After Action Reports and expanded SI Reports for each site summarizing the results from intrusive investigation, sampling events, and ecological and human health risk screenings, and recommending future actions.

The project objectives were used to develop specific DQOs, described in the next subsection. Additional information regarding the overall objectives and general sampling approach is presented in the Work Plan Addendum (CH2M HILL, 2011).

1.6 Quality Objectives and Criteria for Measurement Data

QA involves all those planned and systematic actions necessary to provide adequate confidence that field activities are planned and performed according to accepted standards and practices. This process ensures that the resulting data are valid and retrievable, while continuing to meet minimum safety requirements. QC is an integral part of the overall QA function and is comprised of all those actions necessary to control and verify that project activities and resulting data meet established requirements.

To ensure that a minimum level of certainty about the quality of field data is being met, the following elements will be addressed to meet the requirements specified by the client and regulatory agencies:

- Field operations will be conducted in accordance with written procedures.
- To maintain accuracy within necessary limits, measuring and test equipment (M&TE) used in field investigations will be calibrated against traceable standards at specific intervals, using approved SOPs or manufacturer's instructions.
- When M&TE is found to be out of specification, the previous inspection or test results will be evaluated for validity and acceptability. This evaluation will be documented.
- Before project field work begins, all project staff will be trained to ensure that they are familiar with project Work Plans and associated documents.
- Internal audits may be performed to assess the quality of project activities and to evaluate compliance with established QA requirements.
- QC samples will be used to monitor the quality of field and laboratory techniques and of the data.

1.6.1 Levels of Data Quality

The subsection below lists the levels of data. The level of data quality is dependent on the objective use of the results supported by the data.

The data use determines the required levels of data quality. The two categories of data quality established by USEPA, ***screening*** and ***definitive***, are defined as follows:

Screening data are generated by rapid methods of analysis with less rigorous sample preparation, calibration and/or QC requirements as compared to the requirements for producing definitive data. Screening data may provide analyte identification and quantitation, although the quantitation may be relatively imprecise, unless USEPA reference methods are used. Depending on the DQOs, screening methods may require confirmation samples that generate definitive data. Confirmation samples will be selected to include both detected and nondetected results from the screening technique.

Definitive data are generated using rigorous analytical methods such as approved USEPA reference methods. Data are analyte-specific, and both identification and quantitation are confirmed. These methods have standardized QC and documentation requirements. Definitive data are not restricted in their use unless quality problems require data qualification.

Four levels of data reporting may be performed as part of this field effort, with each level having different supporting QA/QC documentation. The four levels correspond to QC Levels I, II, III, and IV (Level IV data packages will be requested for this project):

- Level I
  Field Surveys (Master QAPP, Section 4.1.1)
- Level II
  Screening Activities, Physical Parameters, and Investigation-derived Waste (IDW) Analyses (Master QAPP, Section 4.1.2)
- Level III
  Laboratory Analysis – Not applicable
- Level IV
  Laboratory Analysis - Level IV data packages provide the most stringent level of documentation, and allows the data reviewer or data validator to recreate the analytical sequence and evaluate raw data such as quantitation reports generated from the instrumentation used in the analyses.

1.6.2 Data Quality Objective Development

DQOs are both qualitative and quantitative statements that define the type, quality, and quantity of data necessary to support the decision-making process during project activities. The intended final use of the data determines the DQOs, which are developed before SAPs.

The credibility of the data is strengthened by the level of the supporting QA/QC documentation. The greater the importance of the data or the resulting decision, the more QA/QC information is needed to validate the data. This reasoning must be applied to the data collected for any project. The DQO process used for this project follows the *USEPA Guidance for the Data Quality Objectives Process (QA/G-4)* (USEPA, 2000).

1.6.3 Quality of Data

Analytical performance requirements are expressed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCC).

Section 4.2 of the Master QAPP (CH2M HILL, 2008) provides a detailed discussion of data quality.

1.6.4 Project Quality/Systematic Planning Process Statements and Data Quality Objectives

The data will be used by the Department of the Navy (Navy), CH2M HILL, USEPA, and NCDENR. Within each organization the data will be used by staff scientists/engineers and PMs.

- What are the Project Action Limits (PALs)?
  - Concentrations of contaminants identified in surface and subsurface soil samples will be compared to the NCDENR Hazardous Waste Section Soil Screening Levels (NC SSLs) (NCDENR, 2010), USEPA Regional Screening Levels (RSLs) for residential/industrial soils (USEPA, 2010), and Base background levels.
- What will the data be used for?
  - Data will be used to evaluate potential surface and subsurface soil impacts associated with MEC, and to evaluate the potential risks to human health and ecological receptors.
- What types of data are needed?
  - The Work Plan Addendum (CH2M HILL, 2011) defines the matrices and analytes for the subject sites. Data collected during the sampling events will be used to assess human health and ecological risks associated with exposure to media at each MMRP site.
  - Field activities will be recorded in a field notebook to document adherence to the approved Work Plan Addendum. The CH2M HILL SOP entitled *Preparing Field Log Books* describes the necessary documentation required for log book completion.
- How "good" must the data be to support the environmental decision?
  - The data need to be of sufficient quality for determining the concentration of constituents in media collected such that the project objectives can be achieved.
  - During the intrusive investigation, QA/QC surface and subsurface soil samples will be collected as a check on sampling and analytical protocol.
- How much data should be collected (number of samples for each analytical group, matrix, and concentration)? Where, when, and how should the data be collected/ generated?
  - Approximately two post-detonation surface soil samples will be collected from the crater of each controlled detonation/blow-in-place (BIP) event, and from the ejecta surrounding each controlled detonation/BIP crater. Surface soil samples within the crater of each BIP event following the TR-02-1 sampling method, as discussed in Section 3.4 of the Work Plan Addendum (CH2M HILL, 2011). In the instances where MEC/MPPEH filler appears to have leaked to the adjacent soil, composite soil samples will be collected using the TR-02-01 sampling approach. Surface soil samples collected from the ejecta surrounding each BIP crater will be collected following the incremental soil sampling approach, as discussed in Section 3.4 of the Work Plan Addendum (CH2M HILL, 2011). The final number of surface soil samples will depend on the number of BIPs and the discovery of evidence of a release of MC. Up to six samples have been anticipated.
  - All post-detonation surface soil samples will be analyzed for target analyte list (TAL) metals, explosive residues including PETN and nitroglycerin, and perchlorate.

- Sample quantities, including QA/QC samples, for each chemical analysis are discussed in the Table 3-7 of the Work Plan Addendum (CH2M HILL, 2011).
- The laboratory will generate data in accordance with the SOPs presented in **Attachment 1**, Table 2, *Analytical SOP References Table.*

- Who will collect and generate the data? How will the data be reported?
  - CH2M HILL field staff will collect the soil samples for analysis.
  - Chemical analyses for metals will be performed by Environmental Conservation Laboratories (ENCO), and analyses for explosive residues and perchlorate will be performed by their subcontractor, GEL Laboratories. Both laboratories are Department of Defense (DoD)-Environmental Laboratory Accreditation Program (ELAP) certified. ENCO is under subcontract to CH2M HILL for this work.
  - All chemical data will be reported in an expanded SI Report and an AAR for each site.
- How will the data be archived?
  - Data will be archived according to procedures dictated via the CLEAN program/ contract. All analytical data will be uploaded into a centralized database developed and maintained by CH2M HILL and used for Navy projects. At the end of the project, paper copies of archived laboratory data will be returned to the Navy.
- Project quality objectives (PQOs) listed in the form of if/then qualitative and quantitative statements:
  - If constituents are detected at concentrations exceeding screening levels (i.e., NC SSL, RSLs, and Base background levels), then human health and ecological risk assessments will be conducted.
  - If human health and/or ecological risks are identified, then additional sampling may be required to delineate risks in support of soil mitigation as IDW disposal. A separate technical memorandum will be submitted to outline the approach for sampling and mitigation.

1.7 Special Training, Requirements, and Certifications

The PM works with the project delivery manager to assemble a project team that has the necessary experience and technical skills. Part of the work planning process is to identify special training requirements or certifications necessary to execute the project successfully. Special training or certifications required beyond the normal routine requirements have not been identified for this project.

1.8 Documentation and Records

This subsection defines which records are critical to the project and what information needs to be included in reports, as well as the data reporting format and the document control procedures. It is imperative for the defensibility of critical decisions made at the site that proper documents and records be maintained for the field and offsite data gathering activities, so that specific events can be recreated or independently evaluated. The PM will be responsible for organizing, storing, and cataloging all project information. See Section 6.7 of the Master QAPP (CH2M HILL, 2008) for specifics.

1.8.1 Field Documentation

See Section 6.7.1 of the Master QAPP (CH2M HILL, 2008) for specific information pertaining to Field Documentation.

1.8.2 Laboratory Documentation

Calculations to be used for data reduction are specified in the referenced analytical methods. Whenever possible, analytical data will be transferred directly from the instrument to a computerized data system. Raw data will be stored electronically, and a hard copy file will be maintained. Laboratory data entered will be sufficient to document information used to arrive at reported values. Electronic data storage will be utilized when possible. All electronic data will be maintained in a manner that prevents inadvertent loss, corruption, and inappropriate alteration. Raw data will be examined to assess compliance with quality control guidelines. Deviations from guidelines will call for corrective action. Deviations determined to be caused by factors outside the laboratory's control, such as matrix interference, will be noted with an explanation in the report narrative. Calculations will be checked and the report reviewed for errors and oversights.

Upon completion, a report will be reviewed for discrepancies, errors, or omissions. Data will then be submitted to the laboratory Quality Assurance Manual (QAM) for review and approval. The laboratory QAM will review the package, ensure that any necessary corrections are made, and give the package to the laboratory PM for review. A copy of the data package will be filed in the project file. Mailed data packages, along with applicable electronic data deliverables, will be sealed in an appropriate shipping container and logged into a document mailing log.

The requested turn-around time for the majority of the definitive data will be 7 days from the time of sample receipt at the laboratory.

2 Measurement and Data Acquisition

Section 2 describes the measurement and data acquisition procedures and the analytical methods to be performed in support of this monitoring. It addresses the following aspects of measurement and data acquisition:

- Sampling process design
- Sampling method requirements
- Sample handling and custody requirements
- Analytical method requirements
- QC requirements
- Instrument and equipment testing, inspection, and maintenance requirements
- Instrument calibration and frequency
- Inspection and acceptance requirements for supplies and consumables
- Data acquisition requirements

2.1 Sampling Process Design

Refer to Section 3 of the Work Plan Addendum (CH2M HILL, 2011) for details for sampling design and rationale.

2.2 Sampling Method Requirements

Refer to Section 3.4 of the Work Plan Addendum (CH2M HILL, 2011) and Section 5.3 of the MRP MPP (CH2M HILL, 2010) for details regarding sampling methods.

2.3 Sample Handling and Custody Requirements

See Section 6.0 of the Master QAPP (CH2M HILL, 2008) and Section 3.4 of the Work Plan Addendum (CH2M HILL, 2011).

2.4 Analytical Methods Requirements

The list of methods and the corresponding target analytes have been designed to evaluate the potential for contamination at the site. Samples will be analyzed using USEPA-approved methods, and may include methods from the following documents:

- *SW-846–Test Methods for Evaluating Solid Wast*e (USEPA, 1998)
- *Annual Book of the American Society for Testing and Materials (ASTM) Standards* (1993)
- *Methods for Chemical Analysis of Water and Wastes* (USEPA, 1983)

Refer to **Attachment 1**, Table 3, *Analytical Services Table,* for a table of the analytical services to be performed during intrusive investigation sampling activities.

Refer to **Attachment 1**, Table 4, *Analytical SOP Requirements Tables,* for analytical methods to be used for the analysis of the target compounds, the containers needed for sampling including preservation requirements and maximum holding times.

2.4.1 Analytical Methods.

Refer to **Attachment 1**, Table 3, *Analytical Services Table,* for the list of analytical methods to be used.

Refer to **Attachment 1**, Table 2, *Analytical SOP References Tables,* for the list of analytical SOPs to be followed during analysis.

2.4.2 Detection, Quantitation, and Reporting Limits

2.4.2.1 Detection Limits

The detection limit (DL) is the minimum amount of an analyte that can be routinely identified using a specific method and instrument measured and reported with 99 percent confidence that the analyte concentration is greater than zero.

2.4.2.2 Limit of Detection

The limit of detection (LOD) is the smallest amount or concentration of a substance that must be present in a sample in order to be detected at a 99 percent confidence level. All non-detects are to be reported at the LOD. The LOD is determined using the laboratory-established DL.

2.4.2.3 Limit of Quantitation

Quantitative results can only be achieved at or above the limit of quantitation (LOQ). The LOQ is defined as the lowest concentration of a substance that produces a quantitative result within specified limits of precision and bias. For results falling between the DL and the LOQ, a "J" flag will be applied to the results indicating the variability associated with the result.

2.4.3 Target Analytes and Reporting Limits

Refer to **Attachment 1**, Tables 5A and 5B, *Reference Limits and Evaluation Tables.*

2.5 Quality Control Requirements

See Section 10.0 of the Master QAPP (CH2M HILL, 2008) for a discussion of QC requirements.

Refer to **Attachment 1**, Table 6, *Laboratory QC Samples.*

Refer to **Attachment 1**, Table 7A and 7B, *Field QC Samples.*

2.6 Field and Laboratory Corrective Action

See Section 14 of the Master QAPP (CH2M HILL, 2008).

2.7 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

2.7.1 Field Instruments

All equipment used for field measurements will be maintained in accordance with the manufacturer's instructions. Routine maintenance and all equipment repairs will be documented in the site logbook. Whenever a piece of equipment fails to operate properly, the instrument either will be repaired in-house, if possible, or be sent out for repair, and another instrument equivalent to the original will be substituted, if possible. Other than solutions/standards for calibrating the equipment, the field team keeps only a limited amount of supplies on hand. Parts are ordered on an as-needed basis.

2.7.2 Analytical Laboratory Instruments

Preventive maintenance for laboratory instruments is discussed in greater detail in **Attachment 1**, Table 8, *Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table*.

2.8 Instrument Calibration and Frequency

See Section 7 of Master QAPP (CH2M HILL, 2008).

Refer to **Attachment 1**, Table 10, *Analytical Instrument Calibration Table.*

2.9 Inspection and Acceptance Requirements for Supplies and Consumables

All services, including subcontracted services and supplies received from vendors, must meet the project scope, specified levels of quality, and the submittal schedule. Field and laboratory personnel must evaluate the vendor's ability to provide the services and specify acceptance requirements for supplies and consumables. For example, laboratories rely on suppliers for solvents, gases, consumables, and analytical equipment, including instrument maintenance. The laboratory should have and maintain adequate contracts with its vendors to receive uninterrupted supplies, parts, and services.

2.10 Data Acquisition Requirements

In addition to the electronic data, the laboratory provides hard-copy deliverables of the analytical results. The hard-copy data packages are filed onsite until the project is completed. At that time, the data packages are sent to the PM for inclusion into the project files. Alternatively, the hard-copy data packages are stored at an offsite warehouse for a period of 10 years after the project close out.

3 Assessment and Oversight

Section 3 describes the assessment and oversight activities that will be followed to determine whether the QC measures identified in the Work Plan Addendum and this QAPP are being implemented and documented as required.

Audits and reviews are the tools used to implement this process. For example, during a review, the auditor may check that a monitoring well has been correctly sampled or that the field QC samples were collected at the appropriate frequency. During an audit or review, the auditor may check for:

- Adherence to the Work Plan Addendum
- Documentation of the process or system
- Proper identification, resolution, and documentation of nonconformance with the process or system
- Correction of identified deficiencies

3.1 Assessments and Response Actions

The need for an audit can be determined independently by the PM. Assessment activities may include surveillance, inspection, peer review, management system review, readiness review, technical systems audit, performance evaluation, and data quality assessment. The PM will be responsible for initiating audits, selecting the audit team, and overseeing audit implementation. For the fieldwork, an audit will be conducted during the sampling activities.

The laboratory will be audited in accordance with the laboratory subcontract. The PC or a designee will perform laboratory audits in compliance with the subcontract. One laboratory audit will be performed before the receipt of samples at the laboratory. A follow-up meeting will be held to address any deficiencies or issues identified during the audit.

Field audits will be conducted by a review team member as designated by the PM. One field audit, if requested, will be performed during the first week of sampling.

3.1.1 Laboratory Performance and System Audits

Laboratory systems will be audited in accordance with the project-specific requirements. Contracted laboratories may be required to submit a laboratory Comprehensive Quality Assurance Plan (CompQAP). The CompQAP must reference relevant SOPs and the laboratory's internal procurement policies and corrective action program.

The laboratory audit will address at least the following issues:

- Is the laboratory operation being performed as required by the subcontract?
- Are internal laboratory operations being conducted in accordance with the laboratory CompQAP?
- Are the laboratory analyses being performed in accordance with method requirements?

Any nonconformance noted during an audit will result in a corrective action.

3.1.2 Field Team Performance and System Audits

The PC or other member of the review team, as designated by the PM, will conduct an audit of the field activities in accordance with the program requirements. The audit will address at least the following issues:

- Are sampling operations being performed as stated in the Work Plan?
- Are the sample labels being filled out completely and accurately?
- Are the chain-of-custody records complete and accurate?
- Are the field notebooks being filled out completely and accurately?
- Are the sampling activities being conducted in accordance with the Work Plan and approved SOPs?
- Are the documents generated in association with the field effort being stored as described in the Work Plan?

The generation and documentation of field data also will be audited. Audits will focus on verifying that proper procedures are followed so that subsequent sample data will be valid. Any nonconformance noted during an audit will result in a corrective action.

The results of the assessment and oversight activities will be reported back to the PM, who has ultimate responsibility for ensuring that the corrective action response is completed, verified, and documented.

Refer to **Attachment 1**, Table 10, *Field Performance Audit Checklist.*

3.2 Reports to Management

Reports to the PM include project status reports, the results of evaluation and system audits, data quality assessments, and significant QA problems and recommended solutions. The status reports, submitted in accordance with the requirements of the Work Plan, will discuss at least current activities, problems encountered and their resolution, and planned work.

QA reports will be submitted in accordance with the Work Plan. QA reports document implementation of the QAPP and the results of the site-specific QA/QC audits. A final QA report must be submitted as part of each project's final report. The topics to be covered are outlined in the Work Plan, but each will include at least the following information:

- Identification of nonconformances that required corrective action and resolution of the nonconformance
- Data quality assessment in terms of precision and accuracy and how they affect the usability of the analytical results
- Limitations of the qualified results and a discussion of rejected results
- Discussion of the field and laboratory QA/QC sample results
- The results of external laboratory audits

The Field Team Leader will provide feedback to the PM discussing all field activities, changes to field procedures, problems encountered, and corrective actions taken.

4 Data Review, Validation, and Verification Requirements

This subsection addresses the QA activities that occur after the data collection has been completed. Implementation of these elements, which include data review, validation, and reconciliation to DQOs, will determine the extent to which the data conform to the specified criteria and satisfy the project objectives.

4.1 Data Review, Validation, and Verification Requirements

See Section 9 of the Master QAPP (CH2M HILL, 2008)[1].

The data are evaluated for precision, accuracy, and completeness against the analytical protocol requirements. Non-conformances or deficiencies that could affect the usability of data are identified as noted.

All analytical data will be supported by a data package. The data package will contain the supporting QC data for the associated field samples. Before the laboratory will release each data package, the laboratory QAM (or the analytical section supervisor) must carefully review the sample and laboratory performance QC data to verify sample identity, the completeness and accuracy of the sample and QC data, and compliance with method specifications.

4.2 Verification and Validation Methods

4.2.1 Data Verification

Before the analytical results are released by the laboratory, both the sample and QC data will be reviewed carefully to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data will be reduced and spike recoveries will be

[1] Note that what is considered Level 3 QC in the Master QAPP is required for this project and that data will be reported with a "Level IV" deliverable.

included in control charts, and the resulting data will be reviewed to ascertain whether they are within the laboratory-defined limits for accuracy and precision. Any non-conforming data will be discussed in the data package cover letter and case narrative. The laboratory will retain all of the analytical and QC documentation associated with each data package.

As discussed previously, the data are also verified to assess whether the electronic data deliverables (EDDs) and the hard-copy data deliverables are consistent with one another to ensure an accurate database.

4.2.2 Data Validation

The PC will ensure that the laboratory analyzed the samples using the correct methods and that all analytes from each analysis group are reported (as per tables 6A, 6B, and 6C). The quantitation limits utilized by the laboratory for the project will be compared to the quantitation limits presented in tables 6A, 6B, and 6C. If quantitation limits were not met, the reason will be determined and documented. Field QC sample results will be documented, the PC will establish that all required QAPP QC samples were run and met limits.

All non-analytical field data will be reviewed by the field team leader. Non-analytical field data will be compared against QAPP requirements for completeness and accuracy based on the field calibration records.

4.3 Usability Assessment

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

It is the responsibility of CH2M HILL's PC to ensure that the analytical data meet the method detection limits, reporting limits, and laboratory QC limits listed in this QAPP, the laboratory statement of work, and the various methods. During this assessment, non-conformances are documented, the data are qualified for use in decision making, and for 10 percent of the results the entire analytical process is reconstructed and recalculated from the raw data.

Non-detected site contaminants will be evaluated to ensure that project required quantitation limits (**Attachment 1**, Tables 5A and 5B, *Reference Limits and Evaluation Tables*) were achieved. If project quantitation limits were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable. 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 between the two results. Deviations from the QAPP 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 a 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.

Identify the personnel responsible for performing the usability assessment:

- PC – Anita Dodson/CH2M HILL
- PM – Keith LaTorre/CH2M HILL

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

All the results will be assembled and statistically reported for an overall quality assessment provided in the final project event report. Discussion will cover completeness and representativeness.

Data tables will be produced to reflect detected and non-detected site contaminants and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation. Figures will be produced representing concentrations of contamination.

4.3.1 Data Quality Evaluation

The PC or designee will perform the data quality evaluation (DQE). The DQE process is used to assess the effect of the overall analytical process on the usability of the data. The two major categories of data evaluation are laboratory performance and matrix interferences. Evaluation of laboratory performance is a check for compliance with the method requirements. It is a straight-forward examination–either the laboratory did, or did not, analyze the samples within the limits of the analytical method. Evaluation of the matrix interferences is more subtle and involves analysis of several results, including surrogate spike recoveries, matrix spike recoveries, and duplicate sample results.

The entire data set will be evaluated for overall trends in data quality and usability. Information summarized as part of the DQE may include chemical compound frequencies of detection, dilution factors that might affect data usability, and patterns of target compound distribution. The data set also will be evaluated to identify potential data limitations or uncertainties in the laboratory.

4.3.2 Reconciliation with Data Quality Objectives

The final activity of the data evaluation process is to assess whether the data meet the planned DQOs for the project. The final results, as adjusted for the findings of any data evaluation, will be checked against the DQOs, and an assessment will be made as to whether the data are of sufficient quality to support the DQOs. The decision as to data sufficiency may be affected by the overall precision, accuracy, and completeness of the data.

The main project objective should be met assuming the 90 percent completeness goal is obtained after all of the data have undergone sufficient data validation. If the data, after evaluation, are sufficient to achieve project objectives, the data quality and PMs will release the data and work may proceed.

5 References

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TABLE 1
Communication Pathway and Procedures, Distribution List, and Project Personnel Sign-Off Sheet

Name of Quality Assurance Project Plan (QAPP) Recipient	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address	Communication Drivers	Procedure, Pathway, etc.	QAPP Section Reviewed	Date QAPP Read
Dave Cleland	Remedial Project Manager	Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic	(757) 322-4851	david.t.cleland@navy.mil	Communication with Marine Corps Base Camp Lejeune (MCB CamLej)	Primary point of contact (POC) for MCB CamLej; can delegate communication to other internal or external POCs. Remedial Project Manager (RPM) will notify the United States Environmental Protection Agency (USEPA) and North Carolina Department of Environmental and Natural Resources (NCDENR) via email or telephone call within 24 hours for field changes affecting the scope or implementation of the design. The Department of the Navy (Navy) will have 21 days for Work Plan review. All sampling data will be presented and discussed during partnering meetings.		
Charity Rychak	Environmental Engineer	MCB CamLej Environmental Management Division (EMD)/ Environmental Quality Board (EQB)	(910) 451-9385	charity.rychak@usmc.mil	Communication with MCB CamLej	POC for MCB CamLej		
Gena Townsend	Environmental Engineer	USEPA Region 4	(404) 562-8538	townsend.gena@epa.gov	Communication with USEPA	POC for USEPA		
Randy McElveen	Remedial Project Manager	NCDENR	(919) 508-8467	randy.mcelveen@ncdenr.gov	Communication with NCDENR	Primary POC for NCDENR; can delegate communication to other internal or external POCs. Upon notification of field changes, NCDENR will have 24 hours to approve or comment on the field.		
Teg Williams	Senior Hydrologist / Senior Technical Consultant (STC)	CH2M HILL	(704) 329-0073	teg.williams@ch2m.com	Technical communications for project implementation, and data interpretation	Contact STC regarding questions/issues encountered in the field, input on data interpretation, or as needed. STCs will have 24 hours to respond to technical field questions, as necessary. Additionally, STCs will review the data, as necessary, prior to partnering team discussion and reporting review.		

TABLE 1
Communication Pathway and Procedures, Distribution List, and Project Personnel Sign-Off Sheet

Name of Quality Assurance Project Plan (QAPP) Recipient	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address	Communication Drivers	Procedure, Pathway, etc.	QAPP Section Reviewed	Date QAPP Read
Keith LaTorre	Project Manager	CH2M HILL	(865) 769-3204	keith.latorre@ch2m.com	Communications regarding project management and implementation/ Field Corrective Actions (CAs)	All information and materials about the project will be forwarded to the Navy, Activity Mangers and Senior Consultants as soon as possible, as necessary. POC for field sampling team. Field and analytical issues requiring CA will be determined by the FTL and/or PM on an as needed basis; the PM will ensure QAPP requirements are met by field staff for duration of project.		
Carl Woods	CH2M HILL Health and Safety (H&S) Manager	CH2M HILL	(513) 319-5771	carl.woods@ch2m.com	H&S	Responsible for generation of the Health and Safety Plan (HSP) and approval of the activity hazard analyses (AHAs) prior to the start of field work. The Project Manager (PM) will contact the H&S Manager as needed regarding questions/issues encountered in the field.		
Noah Weinberg	Field Team Leader (FTL)	CH2M HILL	(623) 521-4503	noah.weinberg@ch2m.com	Work Plan changes in field/ QAPP Field Changes/ Field Progress Reports/ Field CAs	Documentation of deviations from the Work Plan will be made in the field logbook and the PM will be notified immediately. Deviations will be made only with approval from the PM. Documentation of field activities and Work Plan deviations (made with the approval of Activity Manager (AM) and/or Quality Assurance Officer [QAO]) in field logbooks; provide daily progress reports to PM. Field and analytical issues requiring CA will be determined by the FTL and/or PM on an as-needed basis; the PM will ensure QAPP requirements are met by field staff for duration of project.		
Troy Horn	Project Data Manager (PDM)	CH2M HILL	(757) 671-6288	troy.horn@ch2m.com	Data tracking from field collection to database upload	On a daily basis, tracks data from sample collection through database upload.		
Anita Dodson	Project Chemist (PC)	CH2M HILL	(757) 671-6218	anita.dodson@ch2m.com	Field and analytical CAs/ Release of Analytical Data	Any CAs for field and analytical issues will be determined by the FTL and/or the PC and reported to the PM within 4 hours. No analytical data can be released until validation of the data is completed and has been approved by the PC. The PC will review analytical results within 7 days of receipt for release to the project team.		

TABLE 1
Communication Pathway and Procedures, Distribution List, and Project Personnel Sign-Off Sheet

Name of Quality Assurance Project Plan (QAPP) Recipient	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address	Communication Drivers	Procedure, Pathway, etc.	QAPP Section Reviewed	Date QAPP Read
Ronnie Wambles	Laboratory PM	ENCO Labs	(407) 826-5314	rwambles@encolabs.com	Reporting Lab Data Quality Issues	All quality assurance/quality control (QA/QC) issues with project field samples will be reported within 2 days to the PC by the laboratory.		
Laura Maschoff	Data Validator	DataQual Environmental Services	(314) 330-1327	dataqual@charter.net	Evaluating Lab Data Quality Issues	Performs data validation of laboratory data.		

TABLE 2
Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Date Last Reviewed If Not Revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
ADMIN-14	*Waste Disposal and Characterization, Revision No. 5 (12/1/2009)*	In review	NA	All	NA	ENCO – Jacksonville	N
EXMT-09	*Acid Digestion of Soil and Waste Samples for Analysis by ICP and ICP-MS, Revision No. 5 (12/4/2009)*	In review	Definitive	Solid Metals	NA	ENCO – Jacksonville	N
EXMT-12	*Acid Digestion of Aqueous Samples for Analysis by ICP and ICP-MS, Revision No. 4 (11/30/2009)*	In review	Definitive	Aqueous Metals	NA	ENCO – Jacksonville	N
LOGIN-03	*Receiving Samples, Revision No. 10 (1/23/2010)*	In review	NA	All	NA	ENCO – Jacksonville	N
MET-03	*Mercury in Waters by Digestion / CCVA, Revision No. 4 (12/4/2009)*	In review	Definitive	Aqueous Mercury	FIMS	ENCO – Jacksonville	N
MET-05	*Metals Analysis by ICP-AES, Revision No. 7 (10/30/2009)*	In review	Definitive	Solid and Aqueous Mercury	ICP-AES	ENCO – Jacksonville	N
MET-16	*Mercury in Soils by Digestion / CCVA, Revision No. 4 (3/1/2010)*	In review	Definitive	Solid Mercury	FIMS	ENCO – Jacksonville	N
GL-LB-G-001	*Laboratory Waste Management Plan, Revision No. 19 (Feb 2011)*	--	NA	All	NA	GEL Laboratories	N
GL-OA-E-033	*Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC), Revision No. 19 (Jan 2011)*	--	Definitive	Solid Explosives	HPLC/DAD	GEL Laboratories	N
GL-OA-E-067	*Definitive Low Level Perchlorate Analysis Utilizing LC/MS/MS by EPA Method 6850 Modified, Revision No. 7 (Oct 2010)*	--	Definitive	Solid Perchlorate	LC/MS/MS	GEL Laboratories	N
GL-SR-E-001	*Sample Acceptance Policy, Sample Login and Storage, Revision No. 32 (March 2011)*	--	NA	All	NA	GEL Laboratories	N

TABLE 3
Analytical Services Table

Matrix	Analytical Group	Analytical Method	Data Package Turnaround Time	Laboratory/Organization (name and address, contact person, and telephone number)	Backup Laboratory/Organization (name and address, contact person, and telephone number)
Surface Soil	Target analyte list (TAL) Metals including mercury	SW-846 6010C, 7470A/7471B	7 Calendar Days	Environmental Conservation Laboratories, Inc. (ENCO) 4810 Executive Park Court Suite 111 Jacksonville, FL 32216 Ronald Wambles (407) 826-5314	To be determined (TBD)
	Explosive Residues including PETN and Nitroglycerin	SW-846 8330A		GEL Laboratories, LLC 2040 Savage Road Charleston, SC 29407 843-556-8171	
	Perchlorate	SW-846 6850			

Note that samples will be shipped directly to the laboratory performing the work. Metals samples will be shipped to ENCO-Jacksonville, Explosives and perchlorate samples will be shipped to GEL.

TABLE 4
Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/ SOP Reference	Containers (Number, Size, and Type)	Sample Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/Analysis)
Surface Soil	Metals	SW-846 6010C and 7471A / MET-05 and MET-16	one 4-ounce glass jar	1-2 g/0.3 g (Mercury)	Cool to 4 degrees Celsius (°C)	180 days to analysis, 28 days mercury
	Explosives including PETN and Nitroglycerin	SW-846 8330A/ GL-OA-E-033	one 4-ounce glass jar	2 g	Cool to 4°C	14 days until extraction, 40 days to analysis
	Perchlorate	SW-846 6850/ GL-OA-E-067	one 4-ounce glass jar	1 gram	Cool to 4°C	28 days

TABLE 5A
Reference Limits and Evaluation Table

Matrix: Surface Soil
Analytical Group: Metals including mercury

Analyte	CAS Number	Base Background, milligrams per kilograms (mg/kg)[1]	North Carolina Soil Screening Level (NCSSL) (Jan. 2010) (mg/kg)[1]	Regional Screening Levels (RSLs) Industrial for soil (Nov. 2010) (mg/kg)[1]	RSLs Residential for soil (Nov. 2010) (mg/kg)[1]	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
							Limit of Quantification (LOQ) (mg/kg)	Limit of Detection (LOD) (mg/kg)	Detection Limit (DL) (mg/kg)
Aluminum	7429-90-5	5487	No Criteria (NC)	99000	7700	2874	10	5	2.7
Antimony	7440-36-0	0.447	NC	41	3.1	0.18	2	1	0.49
Arsenic	7440-38-2	0.626	5.8	1.6	0.39	0.195	2	1	0.39
Barium	7440-39-3	14.5	580	19000	1500	7.25	5	0.25	0.019
Beryllium	7440-41-7	0.103	NC	200	16	0.0515	0.05	0.025	0.0071
Cadmium	7440-43-9	0.033	3	80	7	0.165	0.2	0.1	0.014
Calcium	7440-70-2	6360	NC	NC	NC	3180	25	12.5	0.67
Chromium	7440-47-3	6.05	3.8	5.6	0.29	0.145	0.5	0.25	0.05
Cobalt	7440-48-4	0.294	NC	30	2.3	0.147	0.5	0.25	0.03
Copper	7440-50-8	4.83	700	4100	310	2.415	0.5	0.25	0.16
Iron	7439-89-6	3245	150	72000	5500	75	10	5	1.4
Lead	7439-92-1	12.3	270	800	400	6.15	1	0.5	0.24
Magnesium	7439-95-4	238	NC	NC	NC	119	25	12.5	1.4
Manganese	7439-96-5	13.7	65	2300	180	6.85	1	0.5	0.045
Mercury	7439-97-6	0.081	1	31	2.3	0.04	0.0019	0.0081	0.0162
Nickel	7440-02-0	1.21	130	2000	150	0.605	0.5	0.25	0.08
Potassium	7440-09-7	116	NC	NC	NC	58	25	12.5	7.9
Selenium	7782-49-2	0.563	2.1	510	39	0.2815	2	1	0.48

TABLE 5A
Reference Limits and Evaluation Table

Matrix: Surface Soil
Analytical Group: Metals including mercury

Analyte	CAS Number	Base Background, milligrams per kilograms (mg/kg)[1]	North Carolina Soil Screening Level (NCSSL) (Jan. 2010) (mg/kg)[1]	Regional Screening Levels (RSLs) Industrial for soil (Nov. 2010) (mg/kg)[1]	RSLs Residential for soil (Nov. 2010) (mg/kg)[1]	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
							Limit of Quantification (LOQ) (mg/kg)	Limit of Detection (LOD) (mg/kg)	Detection Limit (DL) (mg/kg)
Silver	7440-22-4	0.14	3.4	510	39	0.07	0.5	0.25	0.063
Sodium	7440-23-5	80.9	NC	NC	NC	40.45	25	12.5	9
Thallium	7440-28-0	0.36	NC	NC	NC	0.18	1	0.5	0.32
Vanadium	7440-62-2	8.9	NC	520	39	4.45	0.5	0.25	0.072
Zinc	7440-66-6	10.8	1200	31000	2300	5.4	0.5	0.25	0.19

[1] Project Action Limits (PALs) were developed to be protective of human health and the environment.

[2] Project Quantitation Limit (PQL) Goals are half of the minimum PAL.

Base Background values are 2x the mean of base background concentration for surface soils as applicable to MCB CamLej.

Residential Soil RSL values were adjusted from the USEPA RSLs Table (November 2010).

NC SSLs are from NCDENR (January 2010).

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

In cases where the PAL is less than the laboratory's corresponding LOD *and* DL, if that specific constituent is nondetect, the analyte will be considered not present. However, if it is detected, it will be considered to be an exceedance of the PAL.

TABLE 5B
Reference Limits and Evaluation Table

Matrix: Surface Soil
Analytical Group: Explosive Residues including PETN and Nitroglycerin, and Perchlorate

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

[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals are half of the PAL.
Residential Soil RSL values were adjusted from the USEPA Regional Screening Levels Table (November 2010).

TABLE 5B-1
Percent Recovery Limits

Analyte	CAS Number	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	Relative Percent Difference (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	70	125	30
Nitrobenzene	98-95-3	75	125	30
Nitroglycerin	55-63-0	60	120	30
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

TABLE 6A
Laboratory QC Samples

Matrix: Surface Soil
Analytical Group: TAL Metals
Analytical Method: SW-846 6010C and 7471B / MET-05 and MET-16

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	Same as Method Acceptance Limits
Laboratory Control Sample (LCS)		Percent recoveries must meet control limits 80%-120%	Re-prepare and analyze all associated samples.		Accuracy/ Bias	Same as Method Acceptance Limits
Matrix Spike/Matrix Spike Duplicate (MS/MSD)		Percent recoveries must meet control limits 80%-120% and RPD of 20	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Same as Method Acceptance Limits
Serial Dilution (does not apply to Cold Vapor)	One is performed for each preparation batch with sample concentration(s) > 50x LOQ	The 5-fold dilution result must agree within ± 10% of the original sample result.	Perform Post Digestion Spike		Precision / Accuracy	Same as Method Acceptance Limits
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 samples in the preparatory batch by method of standard additions or qualify results.		Precision / Accuracy	Same as Method Acceptance Limits

TABLE 6B
Laboratory QC Samples

Matrix: Surface Soil
Analytical Group: Explosive Residues including PETN and Nitroglycerin
Analytical Method/SOP Reference: SW-846 8330A/ GL-OA-E-033

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. Blank results must not otherwise affect sample results.	Correct the problem, then see Department of Defense (DoD) Quality Standards Manual (QSM) v4.1 Box D-1.If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/ Laboratory Area Supervisor	Contamination/ Bias	Same as Method Acceptance Limits
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Table 5B-1	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/ Bias	Same as Method Acceptance Limits
MS/MSD		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. Relative Percent Difference (RPD) <30%	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Same as Method Acceptance Limits
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	Same as Method Acceptance Limits
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	Same as Method Acceptance Limits

TABLE 6C
Laboratory QC Samples

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

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

TABLE 7A
Field QC Samples

Matrix: Surface Soil
Analytical Group: TAL Metals
Concentration: Low

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Equipment Rinsate Blank	Metals	One per day of sampling	Bias/ Contamination	No analyte detected > ½ LOQ	S + A
Field Blank		One per week of sampling	Bias/ Contamination	No analyte detected > ½ LOQ	S + A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	4°C$\pm$2°C	S
Field Duplicate		One per 10 samples per matrix	Precision	RPD < 35%	S + A

Refer to Table 6A for MS/MSD information

TABLE 7B
Field QC Samples

Matrix: Surface Soil
Analytical Group: Explosives Residues including PETN and Nitroglycerin, and Perchlorate
Concentration: Low

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error S, A, or S&A
Equipment Rinsate Blank	Explosives Residues including PETN, Nitroglycerin, and Perchlorate	One per day of sampling	Bias/ Contamination	No analyte detected > 1/2 LOQ	S + A
Field Blank		One per week of sampling	Bias/ Contamination	No analyte detected > 1/2 LOQ	S + A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	4°C$\underline{+}$2°C	S
Field Duplicate		One per 10 samples per matrix	Precision	RPD < 35%	S + A

Refer to Table 6B and 6C for MS/MSD information

TABLE 8
Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
ICP-AES (TAL Metals)	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 Table 9	Repeat maintenance activity or remove from service.	Analyst/ Supervisor	MET-05
CVAA (Mercury)	Change the tubing; filter; clean windows; 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	MET-03 and MET-16
HPLC (Explosive 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	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	GL-OA-E-033
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 continuing calibration verification (CCV) does not meet criteria	See Table 9	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data	Analyst/ Supervisor	GL-OA-E-067

TABLE 9
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
ICP-AES (TAL Metals)	Initial Calibration (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	MET-05
	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	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.		
	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.		
CVAA (Mercury)	ICAL	Beginning of each day or if QC exceeds criteria	Min 5 point ICAL and a calibration blank Linear regression correlation coefficient >0.995	Correct problem, repeat ICAL.	Analyst, Supervisor	MET-03 and MET-16
	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	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.		
HPLC (Explosive Residues including PETN and Nitroglycerin)	ICAL	Prior to sample analysis (5 point minimum)	Min 5 point ICAL for all target analytes % relative standard deviation (%RSD) $\leq$20%; or Linear regression correlation coefficient $\geq$0.995; or Non-linear regression R-Squared (COD) ≥ 0.990 (6 pts for non-linear)	Correct problem, repeat ICAL	Lab Section Supervisor	GL-OA-E-033
	ICV	Immediately following ICAL	Analytes must be within 15% of the expected value	Correct problem, rerun ICV. If that fails, repeat ICAL.		

TABLE 9
Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
(Explosive Residues including PETN and Nitroglycerin)	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence	All project analytes must yield within ± 15% of the expected value from the ICAL.	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Lab Section Supervisor	GL-OA-E-033
	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		
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	GL-OA-E-067
	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.		
	Limit of Detection Verification (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.		

TABLE 10
Field Performance Audit Checklist

Project Responsibilities

Project No.: ____Date: ____________

Project Location: _________________________________Signature: _______________

Team Members: ____

____

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

Comments ____

____

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

Comments ____

____

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

Comments ____

____

Sample Collection

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

Comments ____

____

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

Comments ____

____

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

Comments ____

____

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

Comments ____

____

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

Comments ____

____

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

Comments ____

____

Yes No 7) Are photographs taken and documented?

Comments ____

____

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 ____

____

Appendix D
MEC Removal Standard Operating Procedures

The MEC Removal Standard Operating Procedures will be inserted into this work plan after selection of the MEC Removal subcontractor.

Appendix E
Forms

Contents

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Project. ______________________________ Date: ______________

TOPICS DISCUSSED:

1.
2.
3.
4.
5.
6.
7.

MEETING CONDUCTED BY: SIGNATURE:

MEETING ATTENDEES	
Name/Company	Signature
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CANDIDATE: ______________________ POSITION/LEVEL: ______________

CONTRACT: ______________________

REVIEW ITEMS		CANDIDATE QUALIFICATIONS	VERIFIED BY/DATE
EXPERIENCE	REQUIRED: AREA AND YEARS		
	ACTUAL: AREA AND YEARS		
EDUCATION	REQUIRED		
	ACTUAL		
CERTIFICATIONS & REGISTRATIONS	REQUIRED		
	ACTUAL		
TRAINING	REQUIRED		
	ACTUAL		
OTHER	REQUIRED		
	ACTUAL		

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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 PrF-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

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Project: CamLej, Jacksonville, NC Date:	
Supervisor:	Job Activity:
Task Personnel: __________ __________ __________	
List Tasks:	
Tools/Equipment required for Tasks, (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools, hand tools): __________ __________	
Potential H&S Hazards, including chemical, physical, safety, biological and environmental **(Check all that apply and review exposures as they will be encountered in the tasks above):**	

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__Ergonomics
Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__Pinch points	__ plants/insects
__ Electrical	__ Cuts/abrasions	__ Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__Heights/fall> 6′	__ Overhead Electrical hazards	__ Heat stress
Noise	Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__Welding/cutting	__ Demolition
Other Potential Hazards (Describe):		

Hazard Control Measures (Check all that apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tag out __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds Forklift/ Heavy equipment Backup alarms __ Hand/power tools __ Crane w/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 X FA-CPR trained personnel X 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/tag out __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections:	Training: X Hazwaste __ Construction __ Competent person X Task-specific (THA) X Hazcom
Field Notes:			

Supervisor signature:

(Part I)

Project : ______________________________ Date: ________________

TITLE AND NO. OF TECHNICAL SECTION: ______________________________

Work Plan Reference : ______________________________

A. Planned Attendants:

	Name	**Position**	Company
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			

B. Submittals required to begin work:

	Item	Submittal No.	Action Code
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			

I hereby certify that, to the best of my knowledge and belief, the above required materials delivered to the job site are the same as those submitted and approved.

____

____

Project QC Specialist

(continued):

Project : ______________________________ Date: ____________________

C. Equipment to be used in executing work:

1) ______________________________
2) ______________________________
3) ______________________________
4) ______________________________
5) ______________________________

D. Work areas examined to ascertain that all preliminary work has been completed:

____

____

E. Methods and procedures for performing Quality Control, including specific testing requirements:

____

____

A. Persons in attendance: See Meeting Attendance Sheet (attached)

The above methods and procedures have been identified from the project plans and will be performed as specified for the Definable Feature of Work.

Project QC Specialist

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Project.: ______________________ Date: ______________

Title and No. of SSWP Section: ______________________

Description and Location of Work Inspected: ______________________

A. Key Personnel Present:

Name	Position	Company

B. Materials being used are in strict compliance with the contract plans and specifications: ☐Yes ☐No

If not, explain: ______________________

C. Procedures and/or work methods witnessed are in strict compliance with the contract specifications: ☐Yes ☐No

If not, explain: ______________________

D. Workmanship is acceptable: ☐Yes ☐No

State where improvement is needed: ______________________

E. Workmanship is free of safety violations: ☐Yes ☐No

If no, corrective action taken: ______________________

____

Project Quality Control Specialist

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CONTRACTOR QUALITY CONTROL DAILY REPORT CONTINUATION SHEET
(ATTACH ADDITIONAL SHEETS IF NECESSARY)

Date: ______________________________

Contractor: ______________________________

Project: CamLej, Jacksonville, NC

• Y=YES; N=NO; SEE REMARKS BLANK=NOT APPLICABLE	
WORK COMPLIES WITH WORK PLAN AS APPROVED IN INITIAL PHASE	

IDENTIFY DEFINABLE FEATURE OF WORK, LOCATION, AND LIST PERSONNEL PRESENT

INSPECTIONS PERFORMED & WHO PERFORMED TEST

______________________________ ______________________________

Project QC Specialist Date

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Project:	CamLej, Jacksonville, NC
Date:	
QC Inspection Team Leader:	
Inspection Remarks:	
1.)	
2.)	
3.)	
4.)	
5.)	
6.)	
Inspected by	Date

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Project:	CamLej, Jacksonville, NC
Date:	
QC Inspection Team Leader:	
Transect ID/Number team is working in:	
Y N Have all team members processed instruments through ECA before beginning work day?	
Y N Has the team leader documented the daily functional test	
Y N Is sweep equipment in accordance with WP requirements?	
Y N Is grid cell laid out in conformance with WP requirements?	
Y N Does the team execute a smooth sweep of instrument from side to side?	
Y N Are team leader log entries current and legible, and include documentation	
of morning safety brief, tailgate safety brief, and relevant information regarding	
daily functions?	
Y N Has the vehicle inspection form been filled out?	
Y N Is recovered MEC/MPPEH/MD being managed in conformance with WP?	
Other Comments:	
Inspected by	Date

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(PART I)

Project: CamLej, Jacksonville, NC Date: ____________

Area of Inspection: ____

A. Definable Feature Of Work: Status of Inspection:

I hereby certify that, to the best of my knowledge and belief, the work inspected is complete and all materials and equipment used and work performed were completed in accordance with plans submitted and approved.

____

____
Project QC Specialist

(continued):

(PART II)

MEETING ATTENDANCE LIST

Site **,** CamLej, Jacksonville, NC

Meeting:		Date:
Name	Organization	Phone Number

Project: CamLej, Jacksonville, NC	Project Manager: Keith LaTorre	Project QC Mgr/Staff:

Reference Number	Definable Feature of Work	Preparatory		Initial		Follow-Up		Completion		
		Date Planned	Actual Date	Date Planned	Actual Date	Planned Begin/End	Actual Dates	Planned Begin/End	Actual Dates	Status

Project: CamLej, Jacksonville, NC	Project Manager: Keith LaTorre	Project QC Mgr/Staff:

Reference Number	Definable Feature of Work	Preparatory		Initial		Follow-Up		Completion		
		Date Planned	Actual Date	Date Planned	Actual Date	Planned Begin/End	Actual Dates	Planned Begin/End	Actual Dates	Status

E-11: INSPECTION SCHEDULE AND TRACKING FORM

Project: CamLej, Jacksonville, NC	Project Manager: Keith LaTorre	Project QC Mgr/Staff:

Reference Number	Definable Feature of Work	Preparatory		Initial		Follow-Up		Completion		
		Date Planned	Actual Date	Date Planned	Actual Date	Planned Begin/End	Actual Dates	Planned Begin/End	Actual Dates	Status

Page 3 of 3

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Date: ___/____/______
Project: CamLej, Jacksonville, NC
Work Task (Milestone/Activity): ____

Survey Period: ___/____/______ through ___/____/______
Method of Surveillance: COR Review

Evaluation of Contractor's Performance: _______

Evaluation

Corrective Action Required: ☐ Yes ☐ No

Narrative Discussion of Contractor's Performance During Survey Period:

Discussion

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Project: CamLej, Jacksonville, NC

1) Work Task (Milestone/Activity): ________________________

2) Survey Period: ___/____/______ through ___/____/______

3) Description of the Failure/Deficiency that Precipitated the Corrective Action:

Description

4) Description of the Criterion that the Failure/Deficiency was Evaluated Against:

Description

5) Personnel Involved in the Identification of the Failure/Deficiency, Determination of the Appropriate Corrective Action, Approval of the Corrective Action, and Implementation of the Corrective Action:

6) Description of the Corrective Action that was Required:

Description

7) Date/Time of Implementation of the Corrective Action: ___/____/______

Description

8) Follow-Up Information to Prevent Recurrence of Failure/Deficiency (i.e., Need For Revision of Procedures or Specifications):

9) Personnel Responsible for Follow-Up Work:

10) Planned Date for Follow-Up Surveillance: ___/____/______

11) Other Notes:

Other

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(2)CAR #:	(3)PRIORITY: ☐HIGH ☐NORMAL	(4)DATE PREPARED:

PART A: NOTICE OF DEFICIENCY

(5)PROJECT:	
(6)PROJECT MANAGER:	(7)QC MANAGER/STAFF:
(8)CONSTRUCTION MANAGER:	(9)MEC MANAGER:
(10)ISSUED TO (INDIVIDUAL & ORGANIZATION):	
(11)REQUIREMENT & REFERENCE:	
(12)PROBLEM DESCRIPTION & LOCATION: (13)CAP REQUIRED? ☐YES ☐NO (14)RESPONSE DUE:	
(15)ISSUED BY (PRINTED NAME & TITLE): SIGNATURE: DATE:	(16)MANAGEMENT CONCURRENCE:

PART B: CORRECTIVE ACTION

(17)PROPOSED CORRECTIVE ACTION/ACTION TAKEN: NOTE: SUPPORTING DOCUMENTATION MUST BE LISTED ON THE BACK OF THIS FORM AND ATTACHED.	
(18)PART B COMPLETED BY (NAME & TITLE): SIGNATURE: DATE:	(19)QC CONCURRENCE:

PART C: CORRECTIVE ACTION VERIFICATION

(20)CAR VERIFICATION AND CLOSE-OUT: (CHECK ONLY ONE & EXPLAIN STIPULATIONS, IF ANY) ☐APPROVED FOR CLOSURE WITHOUT STIPULATIONS ☐APPROVED FOR CLOSURE WITH FOLLOWING STIPULATIONS COMMENTS/STIPULATIONS:
(21)CLOSED BY (PRINTED NAME & TITLE): SIGNATURE: DATE:

(1) QC Manager: Verify that the total number of pages includes all attachments.

(2) QC Manager: Fill in CAR number from CAR log.

(3) CQC System Manager: Fill in appropriate priority category. High priority indicates resolution of deficiency requires expediting corrective action plan and correction of deficient conditions noted in the CAR and extraordinary resources may be required due to the deficiency's impact on continuing operations. Normal priority indicates that the deficiency resolution process may be accomplished without further impacting continuing operations.

(4) CAR Requestor: Fill in date CAR is initiated.

(5) CAR Requestor: Identify project name, number, CTO, and WAD.

(6) CAR Requestor: Identify Project Manager

(7) CAR Requestor: Identify CQC System Manager.

(8) CAR Requestor: Identify project organization, group, or discrete work environment where deficiency was first discovered.

(9) CAR Requestor: Identify line manager responsible for work unit where deficiency was discovered.

(10) QC Manager: Identify responsible manager designated to resolve deficiency (this may not be work unit manager).

(11) CAR Requestor: Identify source of requirement violated in contract, work planning document, procedure, instruction, etc; use exact reference to page and, when applicable, paragraph.

(12) CAR Requestor: Identify problem as it relates to requirement previously stated. Identify location of work activities impacted by deficiency.

(13) QC Manager: Identify if Corrective Action Plan (CAP) is required. CAP is typically required where one or more of the following conditions apply: CAR priority is High; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent future recurrence.

(14) QC Manager: Identify date by which proposed corrective action is due to QC for concurrence.

(15) QC Manager: Sign and date CAR and forward to responsible manager identified in (10) above.

(16) Responsible Manager: Initial to acknowledge receipt of CAR.

(17) Responsible Manager: Complete corrective action plan and identify date of correction. Typical corrective action response will include statement regarding how the condition occurred, what the extent of the problem is (if not readily apparent by the problem description statement in [12]), methods to be used to correct the condition, and actions to be taken to prevent the condition from recurring. If a CAP is required, refer to CAP only in this section.

(18) Responsible Manager: Sign and date corrective action response.

(19) QC Manager: Initial to identify concurrence with corrective action response from responsible manager.

(20) QC Manager: Check appropriate block to identify if corrective action process is complete so that CAR may be closed. Add close-out comments relevant to block checked.

(21) QC Manager: Indicate document closeout by signing and dating.

Attach clarifications and additional information as needed. Identify attached material in appropriate section of this form.

PART A: TO BE COMPLETED BY PROJECT MANAGER OR DESIGNEE

(1)PROJECT:		
(2)PROJECT MANAGER:	(3)QC MANAGER:	
(4)CAR NO(S) AND DATE(S) ISSUED:		
(5)DEFICIENCY DESCRIPTION AND LOCATION:		
(6)PLANNED ACTIONS	(7)ASSIGNED RESPONSIBILITY	(8) COMPLETION DUE DATE
(9)PROJECT MANAGER SIGNATURE:		

PART B: TO BE COMPLETED BY CQC SYSTEM MANAGER OR DESIGNEE

(10)CAP REVIEWED BY:	DATE:
(11)REVIEWER COMMENTS:	
(12)CAP DISPOSITION: (CHECK ONLY ONE AND EXPLAIN STIPULATIONS, IF ANY) ☐ APPROVED WITHOUT STIPULATIONS ☐ APPROVED WITH STIPULATIONS ☐ APPROVAL DELAYED, FURTHER PLANNING REQUIRED COMMENTS:	
(13)QC MANAGER SIGNATURE:	

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Project. ______________________________ Date: ______________

LOCATION OF WORK: ______________________________

DESCRIPTION OF WORK: ______________________________

WEATHER: ☐(CLEAR) ☐(FOG) ☐(P.CLOUDY) ☐(RAIN) ☐(WINDY)

TEMPERATURE: MIN: ______°F MAX: ______°F

1. Work completed today by subcontractor:

____

____

____

2. Work completed today by QC inspection staff :

____

____

3. All work performed in conformance with Work Plan requirements? ______________________________

If not, explain: ______________________________

____

____

4. Non-conformances/deficiencies reported: ______________________________

____

5. Comments: ______________________________

____

____

____

CERTIFICATION: I certify that the above report is complete and correct and that I, or my representative, have inspected all work identified on this report and have determined to the best of my knowledge and belief that noted work activities are in compliance with work plans and specifications, except as may be noted above.

____

Project QC Specialist

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PROJECT: To: ORIGINAL—Please return to CH2M HILL	NCR No.	Date: Page1
Item: Work Plan Reference : Requirement:		
Nonconformance:		
Issued by: Name:	Title: UXOQC	Organization:
Date:		
Disposition: _____ Accept _______ Reject		
Details		
Disposition Approvals:		
UXOQCS Date	FCR Required? Yes No	
Project Manager Date	Distribution:	
Remarks:		

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Root Cause Analysis (RCA)

Root Cause Categories (RCC): Select the RCC numbered below that applies for the root cause (RC) and/or contributing factor (CF) in the first column, then describe the specific root cause and corrective actions in each column.

1. **Lack of skill or knowledge**
2. **Lack of or inadequate operational procedures or work standards**
3. **Inadequate communication of expectations regarding procedures or work standards**
4. **Inadequate tools or equipment**
5. **Correct way takes more time and/or requires more effort**
6. **Short-cutting standard procedures is positively reinforced or tolerated**
7. **Person thinks there is no personal benefit to always doing the job according to standards**

RCC #	Root Cause(s)	Corrective Actions	RC[1]	CF[2]	Due Date	Date Completed	Date Verified

[1] RC = Root Cause; [2] CF = Contributing Factors (check which applies)

Investigation Team Members

Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date

Determination of Root Cause(s)

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, to determine the root cause, and to 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".

<u>Personal Factors</u>

- Lack of skill of knowledge
- Correct way takes more time and/or requires more effort
- Short-cutting standard procedures is positively reinforced or tolerated
- Person thinks that there is no personal benefit to always doing the job according to standards

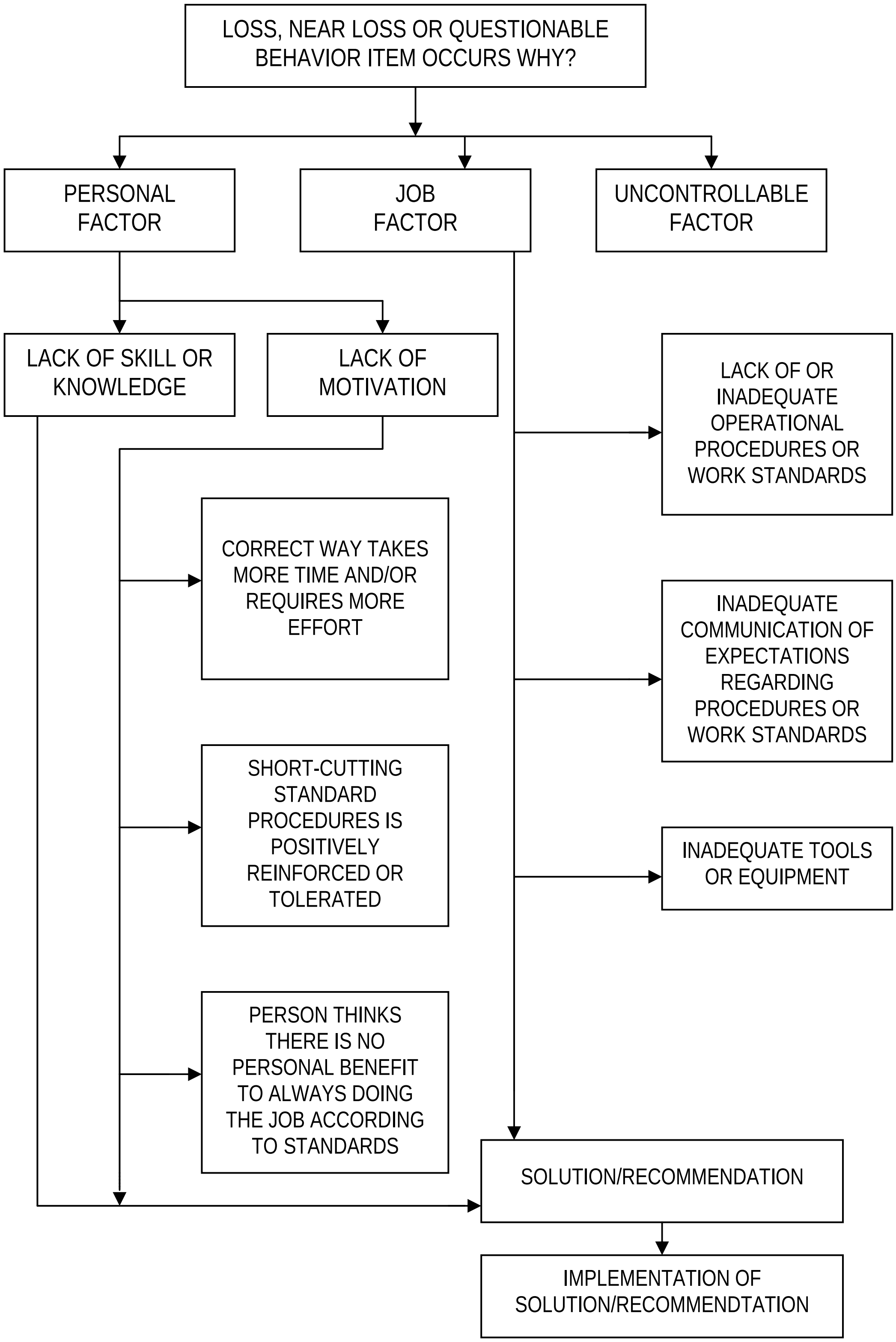
<u>Job Factors</u>

- 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.

Root Cause Analysis
Flow Chart

CH2M HILL, INC.



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Section 1 - Team Information

TEAM:	LOCATION:	DATE:

TEAM MEMBERS

NAME	Company	Position

Section 2 - Equipment Serial Numbers

EQUIPMENT ITEM	Serial #	Equipment Item	Serial #

Section 3 – Checklist

ITEM	Ref.	Inspection Point	Yes	No	N/A	Comments
1	GSV PLAN	EQUIPMENT CHECK PERFORMED IN ECA?	☐	☐	☐	
2	GSV PLAN	DATA COLLECTED IAW WP?	☐	☐	☐	
3	GSV PLAN	WAS PAPERWORK COMPLETED PROPERLY?	☐	☐	☐	
4	GSV PLAN	OBTAIN COPY OF LOGBOOK ENTRIES FROM GEO AND UXO TEAMS.	☐	☐	☐	
5	GSV PLAN	DID TEAM EXPERIENCE ANY PROBLEMS WHILE COMPLETING IVS C?	☐	☐	☐	

Section 4 - Punch list Items

ITEM #	DESCRIPTION

Conducted by: ______________________________

Project QC Specialist: __________

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DATE/TIME: ______________________ TRACKING NUMBER (S): ______________

LOCATION: CamLej, Jacksonville, NC

1. MEC REMOVED FROM SITE ☐ YES ☒ NO

2. WHO REMOVED THE ITEM(S)?

Name: N/A Organization: N/A

3. IF MEC WERE REMOVED, WHERE WERE MEC TAKEN? ☐ DAYBOX ☐ MAGAZINE

4. MEC DESTROYED ONSITE? ☐ YES ☐ NO

5. WHO DESTROYED MEC?

Name: ______________________ Organization: ______________________

Time of Detonation: ______________ MEC Down Time: ______________

6. MEC ENCOUNTERED:

Tracking No.	Transect ID	Team	MEC Type	Qty

7. GOVT. REPRESENTATIVE NOTIFIED AT (TIME): ______________ REP: ______________

8. PROJECT TEAM PERSONNEL NOTIFIED AT (TIME): ______________ REP: ______________

9. NAVFAC NOTIFIED AT (TIME): ______________ REP: ______________

10. COMMENTS (Significant events or findings): ______________

______________________ ______________________

MEC Representative (Signature) MEC Representative (Print Name)

CHECKED BY ________	APPROVED BY ________

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Appendix F
Step 3b Evaluation of
Site 69 Surface Soil and Sediment

Baseline Problem Formulation (Step 3b)

Introduction

This evaluation presents the Baseline Problem Formulation for the ecological risk evaluations associated with the Site UXO-02/Site 69 area. The baseline problem formulation will be established by refining the assumptions that were the basis for the screening level risk estimates for Site UXO-02 (CH2M HILL, 2011) and Site 69 (located within the boundaries of Site UXO-02; [CH2M HILL, 2010]). All constituents of potential ecological concern (COPECs) identified at the conclusion of ERA Steps 1 through 3a for Site 69 (initial desktop analysis) and receptors with complete and significant pathways were retained for Step 3b (the Baseline Problem Formulation). The conclusion of ERA Steps 1 through 3a for Site 69 was that ecological risks to lower trophic level receptors from pesticides in soil and sediment were considered possible. While risks were not predicted based on the Ecological Risk Screening conducted for Site UXO-02, pesticides were not analyzed for in samples collected as part of the Site UXO-02 evaluation. Three samples collected as part of the Site 69 investigation were located outside of the Site 69 boundary and within the Site UXO-02 boundary and indicate that pesticides within Site UXO-02 should be COPECs.

Problem formulation covers the physical layout of the site, its history and ecology, available analytical data, fate and transport mechanisms, complete exposure pathways, and receptors of concern. Together, these components form the site conceptual model. Much of this information was presented in CH2M HILL (2010 and 2011), remains relevant, and therefore is not repeated here. The additional information presented in this baseline problem formulation focuses on the aspects of the site conceptual model that are specific to pesticides. In addition, assessment endpoints, measurement endpoints, and risk questions are developed which will guide the risk analysis of the data proposed for collection.

Risks associated with soils within the Site 69 fence line are not addressed in this problem formulation and work plan. Given that it is an uncontrolled disposal area, it is assumed that measures will be undertaken to eliminate exposure to those soils and further downgradient transport.

This work plan is intended to also address Step 4 of the ERA process, which is the BERA work plan. Data quality objectives have been developed for each of the proposed surface soil and sediment samples. Immediately prior to sampling, a site review will be conducted to confirm that the sample locations shown on the figures in this work plan are appropriate and will meet the objectives of the study. This is referred to as Step 5 of the ERA process, field sampling plan verification. Proposed changes based on field verification will be communicated to the Camp Lejeune Partnering Team.

COPEC Refinement

Refined Ecological Effects Evaluation

The ecological screening values (ESVs) that were used in the screening level ERA and Step 3a at Site 69 to evaluate risk to lower trophic level receptors from pesticides in soil and sediment at Site 69 were further evaluated as part of this Baseline Problem Formulation. An evaluation of the sources and applicability of each ESV was conducted as discussed below by media.

Soil

The soil ESVs used in Step 3a to evaluate risk to lower trophic level receptors from pesticides in soil were reviewed. Selected ESVs were based on either the lowest Ecological Soil Screening Levels (Eco SSL) (USEPA, 2009) or the Region 4 soil ESLs (USEPA, 2001). The EPA Ecological Soil Screening Levels (EcoSSL) (EPA, 2009a) were preferentially selected over Region 4 values (EPA, 2001). When no EcoSSL was available for a constituent, the Region 4 value was selected. The Eco SSL values were considered appropriate when available; however, further review of the Region 4 values that were selected when Eco SSLs values were not available was conducted.

Only two pesticides were retained as COPECs in Step 3a, endrin and gamma BHC. The ESVs used to evaluate these pesticides in Step 3a were based on the 1994 Dutch Target Values (MHSPE, 1994). These values are related to negligible risk for ecosystems. Target values were presented in a more recent circular in 2000 (MHSPE, 2000). The target value presented in the 2000 publication is the same for gamma-BHC but higher for endrin.

Sediment

The ESVs used to evaluate pesticides in sediment were also reviewed. Selected ESVs were based on the Region 4 sediment ESLs (USEPA, 2001). The Region 4 values are based on marine values which are considered appropriate for the estuarine wetlands within and surrounding Site UXO-02 and Site 69. The sediment values were based on either effects range- low (ER-Ls) (Long and Morgan, 1991) or 1994 Threshold Effect Levels (MacDonald, 1994). More recent publications are now available for assessing contaminants in marine or estuarine sediments including the sediment quality guidelines (SQG) by MacDonald published in 1996 which presents threshold effect levels (TELs) (concentration below which adverse biological effects rarely occur), and chemical concentrations corresponding to a 20 percent probability of observing sediment toxicity (T20) published by Field et al. (2002). These more recent values were considered appropriate for assessing impacts to populations and were used when available in place of the older values. T20 values were available for DDD, DDE, DDT, and dieldrin. When T20 values were not available, the SQG values were used. An SQG value was available for chlordane and was used as a surrogate value for alpha-chlordane and gamma-chlordane.

Background Concentrations

A revised background study was recently completed by CH2M HILL to reassess ambient concentrations in soils across the Base. This study is currently under review and remains unpublished to date. As part of this effort, a background or ambient dataset was developed for pesticides in soil. Sediment data were not included as part of this study. Because widespread application of pesticides has been occurring at the Base over the last several decades, pesticide concentrations are often unassociated with site-related activities. In an effort to determine what proportion of pesticide concentrations in the Site 69 data are representative of ambient conditions, the maximum detected pesticide concentrations in surface soils for Step 3a COPECs were compared to the background threshold values for undeveloped areas (combined soil types) calculated as part of the background study. Based on this evaluation, ambient concentrations accounted for 76 percent of the predicted risk for endrin and 15 percent of the predicted risk for gamma-BHC (Table 1). While ambient concentrations appear to account for some portion of the predicted risk, it is likely that site-related activities at Site 69 contributed to the pesticide concentrations seen in surrounding soils and sediments.

Refined COPEC Screening

A refined COPEC screening was conducted using the revised ESVs for soil and sediment.

Soil

Based on the more recent values, risks to lower trophic level organisms from endrin and gamma-BHC are still possible (Table 2). The only pesticides detected in soils were organochlorines. Because no organophosphates were detected in soil, additional soil sampling is only necessary for the two organochlorine pesticides, endrin and gamma-BHC. The other detected organochlorine pesticides in soil were not considered to pose risk and concentrations in downgradient soils are expected to be lower than those in site soils. Consequently, sampling for other organochlorine pesticides in soil is not considered necessary.

Sediment

Based on the revised ESVs, all of the pesticide identified as COPECs for lower trophic level receptors in Step 3a (DDD, DDE, DDT, alpha chlordane, beta-BHC, delta-BHC, dieldrin, endosulfan I, endosulfan sulfate, endrin, gamma-BHC, gamma chlordane, heptachlor, and methoxychlor) remain COPECs. Additionally, based on the identified surrogate screening value, gamma- chlordane was also considered to pose potential risk (Table 3). One organophosphate pesticide, monocrotophos, was detected at an elevated concentration. While an ESV was not available to evaluate this analyte, it was retained as a COPEC because of the elevated concentration.

In sediment, all detected organics with the exception of one organophosphate (monocrotophos) were organochlorines. As a result, additional samples will be analyzed for all the organochlorine pesticides, because multiple analytes were considered to pose potential risk in sediments, and monocrotophos. In addition, sediments samples will be analyzed for total organic carbon (TOC). If necessary, the TOC data can be used to estimate sediment porewater concentrations, which can then be compared to benchmarks derived for surface water. This is important because organic carbon can bind the pesticides, making them less available to many receptors.

Fate and Transport and Complete Exposure Pathways

Preliminary discussion of fate and transport mechanisms and complete exposure pathways has been presented in the Site 69 ERA and Site UXO-02 ERS. These are evaluated in additional detail below.

The source of pesticides in soil and sediment at Site UXO-02 is likely the result of disposal activities at Site 69 as well as the result of standard application of pesticides across the Base. Pesticides may have migrated offsite in stormwater runoff to downgradient soil and sediment.

Based on review of topographic maps of the area, surface runoff from Site 69 flows away from the site in all directions. Soil samples collected to evaluate Site UXO-02 were not previously evaluated for pesticides; however, as part of the Site 69 investigation, six terrestrial locations outside of the Site 69 boundary were sampled for pesticides. In addition, three sediment samples located outside of Site 69 and within Site UXO-02 were analyzed for pesticides as part of the Site 69 effort. Pesticides were detected in soils and sediment samples collected within Site UXO-02 and suggest that overland transport is occurring.

While contaminants in soil have the potential to leach through soils and migrate via groundwater, only 2 of 15 groundwater samples contained detectable concentrations of pesticides. This suggests that migration via the soil to groundwater pathway is not occurring at a significant rate and, while potentially complete, this pathway is considered insignificant.

Similar to groundwater, no pesticides were detected in surface water samples collected within Site UXO-02 (as part of the Site 69 investigation) suggesting that pesticides are not being transported to surface water via groundwater discharge. While pesticides were detected in sediments, they appear to be remaining in sediments and not dissolving into surface water.

Based on these transport pathways, the main media of concern relative to pesticides are soil and sediment within Site UXO-02.

Mechanisms of Toxicity

Mechanisms of toxicity are an important aspect of problem formulation and the development of field sampling plan to address the risk issues. Mechanisms of toxicity for the pesticides COPECs are presented in Table 4.

Endpoints and Risk Questions

Assessment endpoints, measurement endpoints, and risk questions are presented in Table 5.

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TABLE 1

Site 69 Surface Soil Background Comparison - Step 3b

Expanded Supplemental Remedial Investigation Site 69—Operable Unit No. 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Background Threshold Value (BTV)	Ecological Screening Value	EPC Hazard Quotient	BTV HQ	Percent Contribution	Note
Pesticide (UG/KG)										
Endrin	3.80 - 25.0	3 / 11	3.90	IR69-SS05-10A	2.98	0.04	97.5	**75**	76	Background concentrations accoun for 76% of the predicted risk.
gamma-BHC (Lindane)	2.00 - 13.0	4 / 11	8.40	IR69-SS04-10A	1.3	0.050	168	**25**	15	Background concentrations accoun for 15% of the predicted risk.

NOTES

µg/kg - Micrograms per kilogram

HQ - Hazard quotient

mg/kg - Milligrams per kilogram

NSV - No Screening Value

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Checked By: Sara Kent/ATL

TABLE 2

Site 69 Surface Soil Screen - Step 3b

Expanded Supplemental Remedial Investigation Site 69—Operable Unit No. 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Exposure Point Concentration	EPC Basis	Ecological Screening Value	Supplemental Screening Value	Supplemental Screening Value Source	Frequency of Exceedance[1]	EPC Hazard Quotient	Step 3 COPC?	Rationale
Pesticide (UG/KG)													
Endrin	3.80 - 25.0	3 / 11	3.90	IR69-SS05-10A	3.2	95% KM (t) UCL	0.04	--	--	2 / 11	80.5	**YES**	EPC HQ well above one.
gamma-BHC (Lindane)	2.00 - 13.0	4 / 11	8.40	IR69-SS04-10A	4.1	95% KM (t) UCL	0.050	--	--	4 / 11	82.4	**YES**	EPC HQ well above one.

NOTES

[1] - Count of detected samples exceeding or equaling ESV

µg/kg - Micrograms per kilogram

COPC - Contaminant of potential concern

HQ - Hazard quotient

mg/kg - Milligrams per kilogram

NSV - No Screening Value

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Checked By: Sara Kent/ATL

TABLE 3

Site 69 Sediment Screen - Step 3b

Expanded Supplemental Remedial Investigation Site 69—Operable Unit No. 14

MCB CamLej, Jacksonville, North Carolina

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Exposure Point Concentration	EPC Basis[1]	Ecological Screening Value	Supplemental Screening Value	Supplemental Screening Value Source	Frequency of Exceedance[2]	EPC Hazard Quotient	Step 3 COPC?	Rationale
Pesticide (UG/KG)													
4,4'-DDD	4.40 - 4.40	2 / 3	13.0	IR69-SD01D-10A	9.4	Arithmetic mean	2.20	--	--	2 / 3	5.9	**YES**	Arthimetic-based HQ above one; no food chain effects
4,4'-DDE	-- - --	3 / 3	14.0	IR69-SD02-10A	7.95	Arithmetic mean	3.10	--	--	2 / 3	4.52	**YES**	Arthimetic-based HQ above one; no food chain effects
4,4'-DDT	-- - --	2 / 2	5.50	IR69-SD01D-10A	5.00	Arithmetic mean	1.70	--	--	2 / 2	3.24	**YES**	Arthimetic mean-based HQ above one; no food chain effects
alpha-Chlordane	35.0 - 35.0	2 / 3	6.00	IR69-SD01D-10A	6.00	Maximum	2.26	--	--	2 / 3	2.7	**YES**	Maximum-based HQ above one; no food chain effects
beta-BHC	18.0 - 18.0	2 / 3	2.30	IR69-SD01D-10A	2.30	Maximum	NSV	0.32	Gamma-BHC used as surrogate	-- / --	7.2	**YES**	Maximum-based HQ above one; no food chain effects
delta-BHC	2.30 - 35.0	1 / 3	6.70	IR69-SD01D-10A	6.70	Maximum	NSV	0.32	Gamma-BHC used as surrogate	-- / --	20.9	**YES**	Maximum-based HQ above one; no food chain effects
Dieldrin	69.0 - 69.0	2 / 3	2.70	IR69-SD01D-10A	2.70	Maximum	0.820	--	--	2 / 3	3	**YES**	Maximum-based HQ above one; no food chain effects
Endosulfan I	35.0 - 35.0	2 / 3	13.0	IR69-SD01D-10A	10.5	Arithmetic mean	NSV	2.9	USEPA, 2006b	-- / --	3.62	**YES**	Arithmetic-based HQ above one; no food chain effects
Endosulfan sulfate	-- - --	3 / 3	170	IR69-SD02-10A	61	Arithmetic mean	NSV	5.4	USEPA, 2006b	-- / --	11	**YES**	Arithmetic-based HQ above one; no food chain effects
Endrin	14.0 - 69.0	1 / 3	0.97	IR69-SD03-10A	0.97	Maximum	0.020	--	--	1 / 3	48.5	**YES**	Maximum-based HQ above one; no food chain effects
gamma-BHC (Lindane)	7.40 - 35.0	1 / 3	2.00	IR69-SD03-10A	2.00	Maximum	0.32	--	--	1 / 3	6.25	**YES**	Maximum-based HQ above one; no food chain effects
gamma-Chlordane	-- - --	3 / 3	9.10	IR69-SD01D-10A	4.90	Arithmetic mean	2.26	--	--	2 / 3	4.03	**YES**	Arithmetic-based HQ above one.
Heptachlor	35.0 - 35.0	2 / 3	6.00	IR69-SD01D-10A	6.00	Maximum	NSV	0.6	USEPA, 2003	-- / --	10	**YES**	Maximum-based HQ above one; no food chain effects
Methoxychlor	23.0 - 74.0	1 / 3	150	IR69-SD02-10A	66.2	Arithmetic mean	NSV	13.6	USEPA, 2003	-- / --	4.87	**YES**	Arithmetic-based HQ above one; no food chain effects
Monocrotophos	1,900 - 1,900	1 / 2	420	IR69-SD03-10A	420	Maximum	NSV	--	--	-- / --	NSV	NO	Uncertainty, no screening value

NOTES

The categorized analytes were retained for quantitative refinement in the Step 3 table.

[1] - Because of the limited sample size, an upper confidence limit of the mean could not be calculated and the EPC is represented by the lowest of the arithemitic mean or maximum detection.

[2] - Count of detected samples exceeding or equaling Screening Value

COPC - Contaminant of potential concern

HQ - Hazard quotient

mg/kg - Milligrams per kilogram

NSV - No Screening Value

µg/kg - Micrograms per kilogram

Generated By: Kelly Taylor/DFW

Checked By: Sara Kent/ATL

TABLE 4

History, Fate and Transport, and Mechanisms of Toxicity for Pesticides at Site 69

Expanded Supplemental Remedial Investigation Site 69—Operable Unit No. 14

MCB CamLej, Jacksonville, North Carolina

Analyte	Use	Fate and Transport	Mechanism of Toxicity	Source
4,4'-DDD, 4,4'-DDE, 4,4'-DDT	Used to control insects in agriculture and insects that carry diseases such as malaria.	DDT and its metabolites adsorb strongly to soil and are only slightly soluble in water. Loss of these compounds in runoff is primarily due to transport of particulate matter to which these compounds are bound. Because the compounds are bound strongly to soil, DDT would remain in the surface layers of soil and not leach into groundwater. However, DDT can adsorb to free-moving dissolved organic carbon, a soluble humic material that may occur in the soil solution.	Effects the central nervous system causing tremors and convulsions. Also effects reproductive organs.	Toxicological Profile (ATSDR, 2002a)
Aldrin/Dieldrin	Insecticide on crops such as corn and cotton. Also used for termite control.	Aldrin breaks down to dieldrin in the environment. Dieldrin in soil or water degrades very slowly. Dieldrin binds to soil and may remain there unchanged for many years. Most dieldrin in the environment attaches to soil and to sediments at the bottoms of lakes, ponds, and streams. Plants can take up dieldrin from the soil and store it in their leaves and roots. Fish or animals that eat dieldrin-contaminated materials store a large amount of the dieldrin in their fat. It should be noted, however, that the mobility of aldrin and dieldrin in the soil environment, however, can be enhanced at hazardous waste sites where organic solvents may be present.	Effects the central nervous system causing tremors and convulsions.	Toxicological Profile (ATSDR, 2002b)
BHC (alpha, beta, gamma, delta)	Insecticide on fruit, vegetables, and forest crops, and animals and animal premises.	BHC present in soil can leach to groundwater, sorb to soil particulates, or volatilize to the atmosphere. Gamma-BHC generally has low mobility in soils. Adsorption of gamma-BHC to soil particulates is generally a more important partitioning process than leaching to groundwater. In surface waters, gamma-BHC has a tendency to dissolve and remain in the water column and volatilization from surface water is limited. It's ability to adsorb or desorb from sediments is related to the TOC in sediments. BHC and its isomers do not appear to undergo biomagnification in terrestrial food chains to a great extent.	Effects the central nervous system. Cytotoxicity.	Toxicological Profile (ATSDR, 2005)
Chlordane (alpha, gamma)	Pesticide on agricultural crops, lawns, and gardens and as a fumigating agent. Pesticide for termites in homes.	In soil, it attaches strongly to particles in the upper layers of soil and is unlikely to enter into groundwater. Persistence is greater in heavy, clayey or organic soil than in sandy soil. Most chlordane is lost from soil by evaporation. In water, some chlordane attaches strongly to sediment and particles in the water column. It generally does not dissolve in water.	Binds irreversibly to cellular macromolecules, inducing cell death or disrupting normal cell function. Can cause blood dyscrasia, hepatotoxicity, neurotoxicity, immunotoxicity and cancer.	Toxicological Profile (ATSDR, 1994)
Endosulfan I and endosulfan sulfate	Used to control a number of insects on food crops such as grains, tea, fruits, and vegetables and on nonfood crops such as tobacco and cotton. It is also used as a wood preservative.	Endosulfan released to soil attaches to soil particles. Some endosulfan in soil evaporates into air, and some endosulfan in soil breaks down. However it may persist in soil for several years before it all breaks down. Endosulfan does not dissolve easily in water. Most endosulfan in surface water is attached to soil particles floating in the water or attached to soil at the bottom. The small amounts of endosulfan that dissolve in water break down over time.	Mainly a neurotoxin but other effects include liver and kidney toxicity, hematological effects, alterations in the immune system, and alterations in the reproductive organs of males.	Toxicological Profile (ATSDR, 2000)
Endrin	Used as a pesticide to control insects, rodents, and birds.	Highly insoluble in water, highly immobile and persistent in soil, and will not volatilize significantly from water or soil. It has been found in ground water and surface water, but only at very low levels. It is more likely to cling to the bottom sediments of rivers, lakes, and other bodies of water.	Effects the central nervous system causing tremors and convulsions.	Toxicological Profile (ATSDR, 1996)

TABLE 4

History, Fate and Transport, and Mechanisms of Toxicity for Pesticides at Site 69

Expanded Supplemental Remedial Investigation Site 69—Operable Unit No. 14

MCB CamLej, Jacksonville, North Carolina

Analyte	Use	Fate and Transport	Mechanism of Toxicity	Source
Heptachlor	Used for killing insects in homes, in buildings, and on food crops.	Heptachlor binds to soil very strongly and evaporates slowly into the air. Heptachlor does not dissolve easily in water. In soil and water, heptachlor is changed by bacteria into the more harmful substance, heptachlor epoxide, or into other less harmful substances. Plants can absorb heptachlor through their roots from the soil. Sediment in stream beds is likely to contain a lot of the heptachlor that enters the water.	Effects developing nervous systems.	Toxicological Profile (ATSDR, 2007)
Methoxychlor	Used on agricultural crops and livestock, and in animal feed, barns, and grain storage bins for control of flies, mosquitoes, cockroaches, and a wide variety of other insects.	Binds strongly to soil. Most methoxychlor stays in the very top layer of soil, but some of the products that it breaks down into may move deeper into the ground. Smaller amounts of methoxychlor in air may settle directly into rivers, lakes, and other surface waters. Once in water, it usually binds to sediments or organic matter and settles to the bottom.	Reproductive effects.	Toxicological Profile (ATSDR, 2002b)
Monocrotophos	Used to control a variety of sucking, chewing and boring insects and spider mites on cotton, sugarcane, peanuts, ornamentals, and tobacco. Also a bird poison.	Monocrotphos is biodegradable and has a low environmental persistence. Half-life is less than 7 days in soil exposed to natural sunlight.	Cholinesterase Inhibitor - nervous system effects.	EXTOXNET. 1995

TABLE 5

Site 69 Assessment Endpoints, Measurement Endpoints, and Risk Questions - Step 3b

Expanded Supplemental Remedial Investigation Site 69—Operable Unit No. 14

MCB CamLej, Jacksonville, North Carolina

Assessment Endpoint	Guild	Exposure Area	Measurement Endpoint	Risk Questions
Survival, growth, and reproduction of the soil invertebrate community	Soil invertebrates (terrestrial)	Forested areas near Site 69 that could be subject to stormwater runoff	Comparison of the ratio of central tendency exposure concentration and toxicity benchmark to a Hazard Quotient of 1.	Are pesticides present at high enough concentrations over a large enough area to significantly impact the local population of soil invertebrates to the extent that upper trophic level receptors are affected by the loss of a prey base?
			Qualitative field assessment of the health of the soil invertebrate community and analysis of the relationship between presence/absence of organisms and contamination gradients.	
Survival, growth, and reproduction of the benthic invertebrate community	Benthic invertebrates (tidal wetland)	Multiple tidal wetlands located downgradient of Site 69	Comparison of the ratio of central tendency exposure concentration and toxicity benchmark to a Hazard Quotient of 1.	Are pesticides present at high enough concentrations over a large enough area to significantly impact the local population of benthic invertebrates to the extent that other aquatic and terrestrial receptors are affected by the loss of a prey base?
			Qualitative field assessment of the health of the benthic invertebrate community and analysis of the relationship between presence/absence of organisms and contamination gradients.	
Survival, growth, and reproduction of upper trophic level receptors	Multiple	Locations downgradient of Site 69 that are subject to stormwater runoff	Previous ERA work indicated no risk to upper trophic level receptors. Exposure concentrations based on new data will be compared to those used in previous ERA efforts to determine if further risk assessment is warranted.	Are pesticides present at high enough concentrations over a large enough area to significantly impact populations of upper trophic level receptors?