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FINAL ENGINEERING EVALUATION/COST ANALYSIS UNEXPLODED ORDNANCE 14 (UXO14) FORMER INDOOR PISTOL RANGE RR053

8/1/2012

CH2M HILL

Final

Engineering Evaluation/Cost Analysis
UXO-14 – Former Indoor Pistol Range RR-53

Marine Corps Installations East –
Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

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Executive Summary

This report presents an Engineering Evaluation/Cost Analysis (EE/CA) for a Non-Time-Critical Removal Action (NTCRA) at the Site Unexploded Ordnance (UXO) – 14 Former Indoor Pistol Range, RR-53, at Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) in Onslow County, North Carolina (**Figure 1-1**). The Former Indoor Pistol Range is located west of Powder Lane in the Stones Bay area, on level terrain consisting of maintained grass and a loose sandy area in the vicinity of the former building footprint (**Figures 1-2** and **1-3**). This EE/CA addresses the impacted surface soil in the vicinity of the Former Indoor Pistol Range.

Previous site investigations identified potential unacceptable risks to human health and the environment posed by exposure to constituents of concern (COCs), lead and antimony, in impacted surface soil. The removal area is approximately 0.16 acre to a depth of 1 foot below ground surface (bgs), with an estimated volume of approximately 260 cubic yards (yd^3). The purpose of this EE/CA is to develop and analyze removal action alternatives for contaminant mass removal or treatment at the identified removal area. Three alternatives were evaluated:

1. Alternative 1—No Action
2. Alternative 2—Excavation and Offsite Disposal
3. Alternative 3—*In Situ* Soil Stabilization with Excavation and Offsite Disposal

Each technology was evaluated based on effectiveness, implementability, and cost, as summarized in **Table E-1.** The technology to be implemented for the Former Indoor Pistol Range NTCRA will be chosen by the Partnering Team, based on information presented in this EE/CA. The Partnering Team is composed of representatives from MCIEAST-MCB CAMLEJ, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, the North Carolina Department of Environment and Natural Resources (NCDENR), and the United States Environmental Protection Agency (USEPA) Region 4.

TABLE E-1

Summary of Alternative Evaluation

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Excavation and Offsite Disposal	Alternative 3 *In Situ* Soil Stabilization with Excavation and Offsite Disposal
Effectiveness			
Overall protection of human health and the environment	Does not meet RAOs	Meets RAOs through removal of soil from the site.	Meets RAOs through removal of the soil from the site.
Compliance with ARARs	Does not trigger ARARs	Implementation would require compliance with location- and action-specific ARARs. Includes requirements relating to stormwater runoff, dust emissions, management of hazardous and non-hazardous waste, and onsite staging piles.	Implementation would require compliance with location- and action-specific ARARs. Includes requirements relating to stormwater runoff, dust emissions, management of non-hazardous waste, and onsite staging piles.
Long-term effectiveness and permanence	Not effective in the long-term.	All soil with COCs above RAOs would be removed from site. Residual site risk is acceptable.	All soil with COCs above RAOs would be removed from the site. Residual site risk is acceptable.
Reduction of toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, and volume.	Reduces toxicity, mobility, and volume through soil removal. Contaminants are not destroyed, but rather moved to an appropriate permitted disposal facility.	Reduces toxicity, mobility, and volume through soil removal. Stabilization reduces lead mobility in soil. Contaminants are not destroyed, but rather moved to an appropriate permitted disposal facility.
Short-term effectiveness	Not effective in the short-term.	Potential risks to site workers and the nearby community due to construction activity and increased truck traffic. Potential dust emission issues associated with excavation may require engineering controls. Action would require 2 weeks in the field to complete. Potential environmental impact due to transportation of investigation-derived waste (IDW) to disposal facility.	Potential risks to site workers and the nearby community due to construction activity and increased truck traffic. Potential dust emission issues associated with excavation and reagent mixing may require engineering controls. Action would require up to 3 weeks in the field to complete. Potential environmental impact due to transportation of investigation-derived waste (IDW) to disposal facility.
Implementability			
Technical Feasibility	Feasible	Excavation is a standard and reliable technology. Monitoring the technical aspects is easily done.	Excavation and in situ stabilization are reliable technologies. Monitoring the technical aspects is easily done.
Administrative Feasibility	Feasible	Waste being disposed is considered hazardous and would require additional permitting.	Treated waste is non-hazardous, and additional permitting is not necessary for transport or disposal.
Availability of Services and Materials	Not applicable	Services and materials are readily available. Limited number of disposal facilities.	Services and materials are readily available.
State and Community Acceptance	Unlikely	To be determined	To be determined
Cost			
Capital Cost	**$0**	**$387,000**	**$296,000**

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Acronyms and Abbreviations

µg/L	microgram per liter
ARAR	applicable or relevant and appropriate requirement
ASR	Archive Search Report
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	constituent of concern
CSM	Conceptual Site Model
CTO	Contract Task Order
°F	degree Fahrenheit
EE/CA	Engineering Evaluation/Cost Analysis
ESI	Expanded Site Investigation
ERS	Ecological Risk Screening
FS	Feasibility Study
GW	groundwater
HHRS	Human Health Risk Screening
HI	hazard index
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
IR	Installation Restoration
LUC	land use control
MCIEAST-MCB CAMLEJ	Marine Corps Installations East - Marine Corps Base Camp Lejeune
MEC	munitions and explosives of concern
mg/kg	milligram per kilogram
MILCON	military construction
MMRP	Military Munitions Response Program
NA	not analyzed
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NC SSL	North Carolina Soil Screening Level
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Groundwater Quality Standards
NCP	National Oil and Hazardous Substance Pollutions Contingency Plan
NTCRA	Non-time-critical Removal Action
O&M	operation and maintenance
PA/SI	Preliminary Assessment/Site Inspection
PRA	Preliminary Range Assessment
RAGS	Risk Assessment Guidance for Superfund
RAO	removal action objective
RCRA	Resource Conservation and Recovery Act

RI	Remedial Investigation
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act of 1986
SRG	Site Remediation Goal
TAL	Target Analyte List
TBC	to-be-considered
TCLP	Toxicity Characteristic Leaching Procedure
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UU/UE	unlimited use/unrestricted exposure
UXO	Unexploded Ordnance
yd^3	cubic yard

SECTION 1

Introduction

This report presents an Engineering Evaluation/Cost Analysis (EE/CA) for a Non-Time-Critical Removal Action (NTCRA) at Site Unexploded Ordnance (UXO) – 14. UXO-14 is located west of Powder Lane in the Stones Bay area of Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) in Onslow County, North Carolina (**Figures 1-1** and **1-2**). UXO-14 includes the Former Indoor Pistol Range, also known as RR-53 (Archive Search Report [ASR] #2.199) and the Former Gas Chamber area (ASR #2.200) (**Figure 1-3**). The Former Gas Chamber was recommended for no further action based on the results of the Preliminary Assessment/Site Inspection (PA/SI) (CH2M HILL, 2011a) and the Expanded Site Investigation (ESI) (CH2M HILL, 2011b). However, these previous investigations identified potential unacceptable risks to human health and the environment posed by exposure to lead and antimony in surface soil at the Former Indoor Pistol Range. This EE/CA presents removal alternatives to address lead and antimony in surface soil at the Former Indoor Pistol Range. The actions are intended to mitigate the unacceptable risks and are evaluated with respect to effectiveness, implementability, and cost. This EE/CA was prepared by CH2M HILL under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, Contract N62470-11-D-8012, Contract Task Order (CTO) WE43.

1.1 Regulatory Background

This document is issued by the Department of the Navy (Navy), the lead agency responsible for remediation of the Former Indoor Pistol Range, with the assistance of the United States Environmental Protection Agency (USEPA) Region 4 and the North Carolina Department of Environment and Natural Resources (NCDENR), under Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA).

A removal action is being considered for the portion of the Former Indoor Pistol Range where lead and antimony have been identified above the Site Remediation Goals (SRGs). This removal action is not time-critical. NTCRAs are defined in Title 40 of the Code of Federal Regulations (CFR) Section 300.415(b)(4) as actions pertaining to a less imminent threat to human health and the environment and that have planning periods of 6 months or more.

Section 104 of CERCLA and SARA allows an authorized agency to take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release relating to hazardous substances, pollutants, or contaminants at any time, or to take any other response measures consistent with 40 CFR 300 of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), as deemed necessary to protect public health or welfare and the environment.

The NCP provides regulations for implementing CERCLA and SARA and regulations specific to removal actions. The NCP defines a removal action as:

> *[…] cleanup or removal of released hazardous substances from the environment, such actions as may be necessary to monitor, assess, and evaluate the threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release.*

40 CFR Section 300.415 requires the lead agency to conduct an EE/CA when an NTCRA is planned for a site. The goals of an EE/CA are to identify the objectives of the removal action and to analyze the effectiveness, implementability, and cost of various alternatives that may satisfy these objectives. An EE/CA documents the removal action alternatives and selection process.

Community involvement requirements for NTCRAs include preparing an EE/CA and making it available for public review and comment for a period of 30 days. An announcement of the 30-day public comment period on the EE/CA is required in a local newspaper. Written responses to significant comments will be summarized in an Action Memorandum and included in the Administrative Record.

1.2 Purpose and Objectives

The objective of this EE/CA is to evaluate the removal alternatives to address the potential risks posed by lead and antimony in surface soil at the UXO-14 Former Indoor Pistol Range Site, in preparation for site closeout under CERCLA. An EE/CA must be completed for all NTCRAs under CERCLA, as required by section 300.415(b)(4)(i) of the NCP. An EE/CA serves an analogous function to the Remedial Investigation/Feasibility Study (RI/FS) conducted for removal actions, but is more focused and streamlined.

Submittal of this document fulfills the requirements for NTCRAs defined by CERCLA, SARA, and the NCP. This EE/CA has been prepared in accordance with USEPA's guidance document *Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA*, PB93-963402, August 1993. Additionally, this EE/CA shall:

1. Satisfy environmental review and public information requirements for removal actions.
2. Satisfy Administrative Record requirements for improved documentation of the removal action selection.
3. Provide a framework for evaluating and selecting alternative technologies.

1.3 Organization of the EE/CA

The following information is presented within this EE/CA:

- Section 2—Site Characterization
- Section 3—Identification of Removal Action Objectives
- Section 4—Identification of Removal Action Alternatives
- Section 5—Detailed Analysis of Removal Action Alternatives
- Section 6—Comparative Analysis of Removal Action Alternatives
- Section 7—References

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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
Base Location Map
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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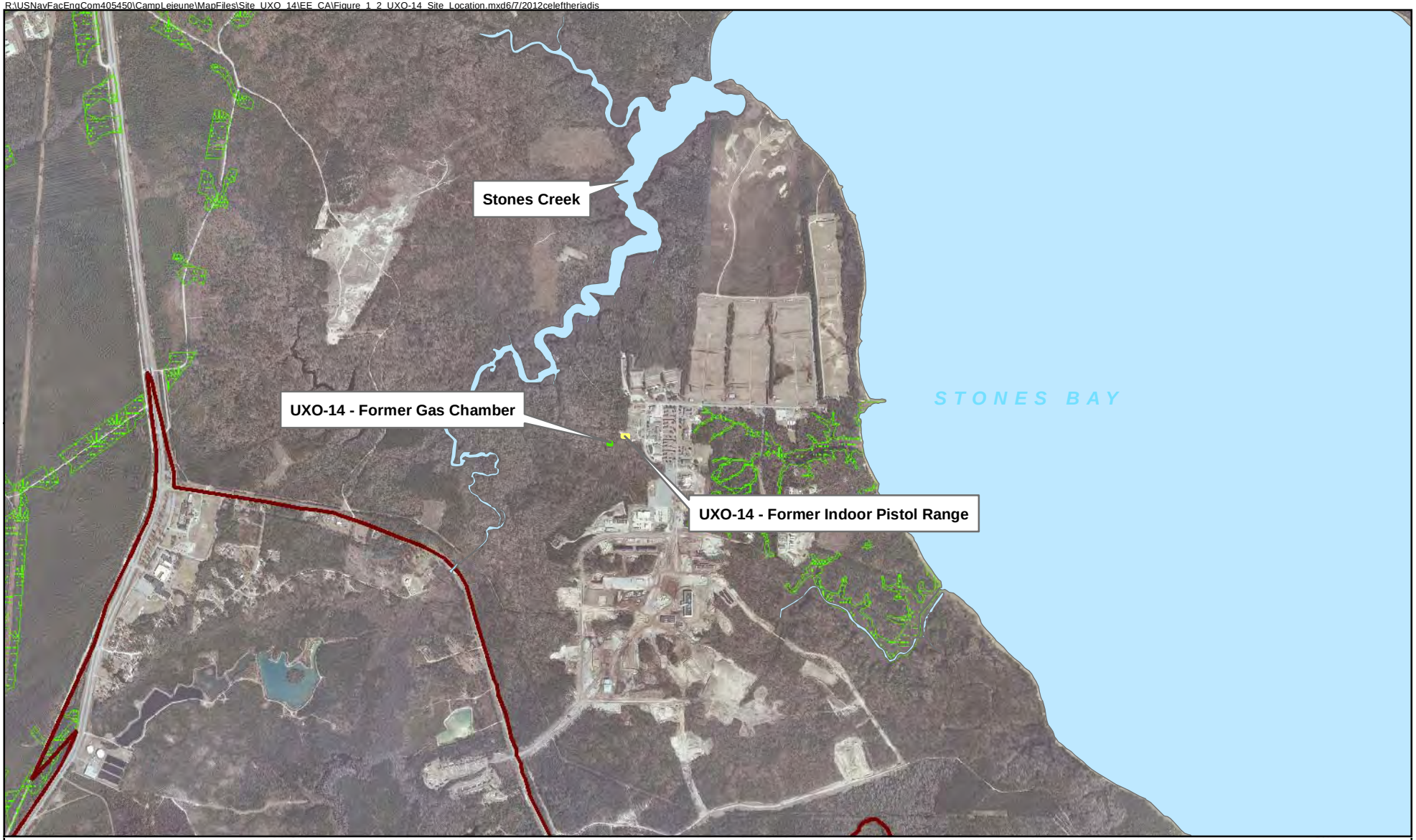

Legend

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

N

0 1,250 2,500 Feet

1 inch = 2,500 feet

Figure 1-2
Site Location Map
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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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 75 150 Feet

1 inch = 150 feet

Figure 1-3
Site Map
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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SECTION 2

Site Characterization

This section contains information on site description, site history, previous investigations and the nature and extent of contamination, risk screening, and determination of the removal action area.

2.1 Site Description

MCIEAST-MCB CAMLEJ is located in Onslow County, North Carolina, covers approximately 236 square miles, and is bisected by the New River, which flows in a southeasterly direction and forms a large estuary before entering the Atlantic Ocean (**Figure 1-1**). The generally flat topography of MCIEAST-MCB CAMLEJ is typical of the seaward portions of the North Carolina coastal plain. Elevations vary from sea level to 72 ft above mean sea level (msl), although the elevation of the majority of MCIEAST-MCB CAMLEJ lies between 20 and 40 ft above msl.

UXO-14 is located in the southwestern portion of MCIEAST-MCB CAMLEJ in the Stones Bay area (**Figure 1-2**). The eastern area of Site UXO-14, the Former Indoor Pistol Range area (ASR #2.199), is comprised of level terrain consisting of maintained grass and a loose sandy area representing the former building footprint. Concrete and construction debris is stockpiled within the Former Indoor Pistol Range area.

2.1.1 Soil and Lithologic Information

Soil cores from borings with depths ranging up to 15 feet below ground surface (bgs) were inspected as part of the PA/SI 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 (Cardinell et al., 1993). Analysis of soil boring logs collected from ground surface to 15 feet bgs indicate sediments of predominantly fine-grained sand interspersed with discontinuous layers of clayey sand and sandy clay (CH2M HILL, 2011a).

2.1.2 Hydrologic and Hydrogeologic Information

Stormwater runoff flows west, eventually discharging to a wetland located west of the site. In general, high rates of infiltration are expected across most of site and erosion at the site is expected to be minimal due to the grassy cover and relatively flat terrain.

The water table of the surficial aquifer is present approximately 5 to 8 feet bgs. Site-specific hydrogeologic information was derived from the installation of four temporary monitoring wells during the PA/SI. Based on groundwater elevation data collected in December 2009, groundwater flow in the surficial aquifer generally flows southwest towards an unnamed tributary of Stones Creek in the vicinity of the Former Indoor Pistol Range (**Figure 1-2**) (CH2M HILL, 2011a).

2.1.3 Surrounding Land Use and Populations

The majority of the area south and west of the Former Indoor Pistol Range is wooded. To the east and north are military buildings, including a woodworking shop with various supporting outbuildings. There are no known current plans for military construction (MILCON) activities to occur in the vicinity of the Former Indoor Pistol Range upon completion of the NTCRA.

There are no water supply wells within 1,500 feet of UXO-14. The closest water supply well is located approximately 10,000 feet off-Base, to the southwest of the Former Indoor Pistol Range area of Site UXO-14.

Potable water to MCIEAST-MCB CAMLEJ and the surrounding residential area is provided by water supply wells. Although freshwater is present within the surficial aquifer, only a deeper aquifer is used by MCIEAST-MCB CAMLEJ as a water supply source (Cardinell, et al., 1993). No water supply wells exist between the Former Indoor Pistol Range and Stones Creek, which is the nearest likely groundwater discharge point (**Figure 1-2**). All the land between the Former Indoor Pistol Range and Stones Creek is owned by MCIEAST-MCB CAMLEJ.

2.1.4 Sensitive Ecosystems

No rare species or sensitive ecosystems have been identified within the Former Indoor Pistol Range area of Site UXO-14.

2.1.5 Meteorology

Mild winters and hot, humid summers characterize the MCIEAST-MCB CAMLEJ area climate. Winters are usually short and mild with occasional and short-duration cold periods. Summers are long, hot, and humid. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53 degrees Fahrenheit (°F) in the winter months to 71°F to 88°F during the summer months. Winds are generally south-southwesterly in the summer and north-northwesterly in the winter (Water and Air Research, Inc., 1983).

2.2 Site History

A detailed review of existing information was conducted to investigate historical activities that could have resulted in the releases of hazardous substances within the area of investigation. This review included interviews with current and former site personnel. Information obtained from this effort is documented in the Archival Records Search Report presented in the PA/SI report (CH2M HILL, 2011a), and is summarized below.

According to the *Range Identification and Preliminary Range Assessment* (PRA), the Former Indoor Pistol Range was located at former Building RR-53, illustrated on Plate 21 of the PRA, and appeared on base maps from 1950 through 1996 (United States Army Corps of Engineers [USACE], 2001). The range, oriented east to west, was used for small arms training from 1950 until it was demolished around 1996 (Richardson, 2008). Appendix A-1 of the PRA describes small arms ammunition as a "cartridge or families of cartridges intended for use in various types of hand-held or mounted weapons through 30 millimeter. Within a caliber designation, these weapons may include one or more of the following: rifles (except recoilless), carbines, pistols, revolvers, machineguns, and shotguns" (USACE, 2001). The PRA does not indicate the quantity of small arms ammunitions used at the Former Indoor Pistol Range.

For typical rifle and pistol ranges, most training is conducted with fixed or stationary targets at known distances, resulting in the formation of "bullet pockets" at the base of the back wall or berm. The high-impact energy of these high-speed rounds with the rounds accumulated in the bullet pockets results in significant fragmentation and ricochet (Interstate Technology & Regulatory Council [ITRC], 2003). This leads to a buildup of metals, such as lead and antimony in one general area, typically at one end, or both, if the shooting direction was ever switched, of the former facility footprint.

2.3 Summary of Previous Investigations

Two site investigations were conducted at Site UXO-14: the PA/SI in 2009 (CH2M HILL, 2011a) and the ESI in 2011 (CH2M HILL, 2011b). The results for these investigations pertaining to the Former Indoor Pistol Range area of Site UXO-14 are discussed in further detail in the sections below.

2.3.1 Preliminary Assessment/Site Inspection (CH2M HILL, 2011a)

In 2009, a PA/SI was conducted to evaluate the potential presence of munitions constituents in environmental media resulting from historical activities, and to evaluate whether additional investigation and/or remediation activities are necessary. The PA/SI approach consisted of collecting 12 surface soil samples from ground surface to a depth of 2 inches, three subsurface soil samples from 2 to 3 feet bgs, and three groundwater samples from the surficial aquifer.

Surface and subsurface soil samples were analyzed for Target Analyte List (TAL) metals using SW-846 USEPA Methods 6010B and 7471B. Groundwater samples were analyzed for total and dissolved metals (SW-846 USEPA Method 6010B). The analytical results for each media are discussed below.

Surface Soil

Antimony, arsenic, chromium, iron, lead, and mercury were detected in at least one of the 12 surface soil samples in exceedance of one of the screening criteria listed in **Table 2-1** below. These exceedance data are depicted on **Figure 2-1** and summarized in **Table 2-2,** and the complete results are included in the PA/SI Table 4-1 included in **Appendix A** (CH2M HILL, 2011a).

TABLE 2-1
PA/SI Surface Soil Screening Levels

Contaminant	MCIEAST-MCB CAMLEJ Background Threshold Value – Undeveloped Sand	NC SSLs (February 2012)	Adjusted Industrial Soil RSLs (June 2011)	Adjusted Residential Soil RSLs (June 2011)
Antimony	0.972	0.9	41	3.1
Arsenic	0.713	5.8	1.6	0.39
Chromium	13.3	3.8	5.6	0.29
Iron	3,950	150	72,000	5,500
Lead	20.9	270	800	400
Mercury	0.0804	1	31	2.3

Notes:
Values in milligrams per kilogram (mg/kg)

TABLE 2-2
PA/SI Surface Soil Screening Results Summary

Contaminant	Frequency of Exceedances	Maximum Concentration (mg/kg)	Maximum Concentration Location
Antimony	5/12	387	SS12
Arsenic	6/12	2.7	SS12
Chromium	12/12	3.76	SS01
Iron	12/12	1,470	SS01
Lead	12/12	35,500	SS12
Mercury	1/12	1.08	SS02

Subsurface Soil

Antimony, chromium, iron, lead, and zinc were detected in at least one of the three subsurface soil samples in exceedance of one of the screening criteria listed in **Table 2-3** below. These data are depicted on **Figure 2-2**, summarized in **Table 2-4**, and the complete results are included in the PA/SI Table 4-2 in **Appendix A** (CH2M HILL, 2011a).

TABLE 2-3
PA/SI Subsurface Soil Screening Levels

Contaminant	MCIEAST-MCB CAMLEJ Background Threshold Value – Undeveloped Sand	NC SSLs (February 2012)	Adjusted Industrial Soil RSLs (June 2011)	Adjusted Residential Soil RSLs (June 2011)
Antimony	1.02	0.9	41	3.1
Chromium	17.8	3.8	5.6	0.29
Iron	5,400	150	72,000	5,500
Lead	6.94	270	800	400
Zinc	5.54	1,200	31,000	2,300

Notes:
Values in milligrams per kilogram (mg/kg)

TABLE 2-4
PA/SI Subsurface Soil Screening Results Summary

Contaminant	Frequency of Exceedances	Maximum Concentration (mg/kg)	Maximum Concentration Location
Antimony	1/3	2.62	IS01
Chromium	3/3	1.06	IS01
Iron	3/3	370	IS01
Lead	1/3	290	IS01
Zinc	1/3	9.98	IS01

Groundwater

Arsenic, chromium, copper, and iron were detected in at least one of three groundwater samples in exceedance of one of the screening criteria listed in **Table 2-5** below. These data are depicted on **Figure 2-3**, summarized in **Table 2-6**, and the complete results are included in the PA/SI Table 4-3 of **Appendix A** (CH2M HILL, 2011a).

TABLE 2-5
PA/SI Groundwater Screening Levels

Contaminant	MCIEAST-MCB CAMLEJ Background Threshold Value	NCGWQS (January 2010)	Adjusted Tap Water RSLs (April 2012)
Arsenic	9.79	10	0.045
Chromium	16.9	10	0.031
Copper	6.59	1,000	620
Iron	16,100	300	1,100

Notes:
Values in micrograms per liter (µg/L)

TABLE 2-6
PA/SI Groundwater Screening Results Summary

Contaminant	Frequency of Exceedances	Maximum Concentration (µg/L)	Maximum Concentration Location
Arsenic	2/3	4.09	TW02
Chromium	3/3	2	TW01
Copper	1/3	103	TW02
Iron	3/3	2,910	TW02

These analytical data results were then used to conduct an initial human health and ecological risk screening, which is discussed in greater detail in Section 2.4 below. Based on the initial results of the PA/SI risk screenings, an ESI was recommended to delineate the extent of identified impacts in surface and subsurface soil, primarily due to the risks associated with antimony, lead, and mercury at the Former Indoor Pistol Range area of Site UXO-14. No unacceptable risks due to exposure to groundwater were identified.

2.3.2 Expanded Site Investigation (CH2M HILL, 2011b)

Based on the results and recommendations of the PA/SI, an ESI was conducted to evaluate the distribution of and potential unacceptable human health and ecological risks associated with antimony, lead, and mercury in soil at the Former Indoor Pistol Range by collecting and evaluating additional surface and subsurface soil samples. The ESI approach consisted of collecting 14 surface soil samples from ground surface to a depth of 2 inches and seven subsurface soil samples at depths ranging from 5 to 8 feet bgs. Surface and subsurface soil samples were analyzed for the metals antimony, lead, and mercury using SW-846 USEPA Methods 6010B and 7471B. The analytical results for each media are discussed below.

Surface Soil

Antimony, lead, and mercury were each detected in at least one of the 14 samples in exceedance of one of the screening criteria listed in **Table 2-7** below. These exceedance data are depicted on **Figure 2-1**, summarized in **Table 2-8,** and included in Table 4-2 from the ESI in **Appendix A** (CH2M HILL, 2011b).

TABLE 2-7
ESI Surface Soil Screening Levels

Contaminant	MCIEAST-MCB CAMLEJ Background Threshold Value – Undeveloped Sand	NC SSLs (February 2012)	Adjusted Industrial Soil RSLs (June 2011)	Adjusted Residential Soil RSLs (June 2011)
Antimony	0.972	0.9	41	3.1
Lead	20.9	270	800	400
Mercury	0.0804	1	31	2.3

Notes:
Values in milligrams per kilogram (mg/kg)

TABLE 2-8
ESI Surface Soil Screening Results Summary

Contaminant	Frequency of Exceedances	Maximum Concentration (mg/kg)	Maximum Concentration Location
Antimony	3/14	2.5 J	SS23
Lead	12/14	886 J	SS31
Mercury	1/14	0.089	SS24

Subsurface Soil

Antimony and lead were each detected in at least one of the seven subsurface soil samples in exceedance of one of the screening criteria listed in **Table 2-9** below. These exceedance data are depicted on **Figure 2-2**, summarized in **Table 2-10,** and included in Table 4-4 from the ESI in **Appendix A** (CH2M HILL, 2011b).

TABLE 2-9
ESI Subsurface Soil Screening Levels

Contaminant	MCIEAST-MCB CAMLEJ Background Threshold Value – Undeveloped Sand	NC SSLs (February 2012)	Adjusted Industrial Soil RSLs (June 2011)	Adjusted Residential Soil RSLs (June 2011)
Antimony	1.02	0.9	41	3.1
Lead	6.94	270	800	400

Notes:
Values in milligrams per kilogram (mg/kg)

TABLE 2-10
ESI Subsurface Soil Screening Results Summary

Contaminant	Frequency of Exceedances	Maximum Concentration (mg/kg)	Maximum Concentration Location
Antimony	1/7	0.842 J	IS07
Lead	5/7	71.5	IS07

2.4 Risk Screening Summary

During the PA/SI, human health and ecological risk evaluations were conducted to identify potential risks posed to various receptors from exposure to soil and groundwater at the Former Indoor Pistol Range. These evaluations were then updated during the ESI. The Conceptual Site Model (CSM) illustrated on **Figure 2-4** depicts possible exposure scenarios for human and ecological receptors.

2.4.1 Human Health Risk Screening

A Human Health Risk Screening (HHRS) was conducted to evaluate the potential for unacceptable risks to humans from exposure to soil and groundwater at the Former Indoor Pistol Range. The HHRS indicated that exposure to groundwater and subsurface soil would not result in any unacceptable risks to human health, but there is potential unacceptable risk associated with exposure to lead and antimony in surface soil. The data evaluated during the HHRS are presented in Appendix E of the ESI (CH2M HILL, 2011b).

2.4.2 Ecological Risk Screening

An Ecological Risk Screening (ERS) was conducted to evaluate the potential for unacceptable risks to ecological receptors from exposure to soil and groundwater at the Former Indoor Pistol Range. The data evaluated during the ERS are presented in Appendix F of the ESI (CH2M HILL, 2011b). The results of the ERS indicated that exposure to groundwater would not result in any unacceptable risks to ecological receptors.

Antimony and lead in surface and subsurface soil were identified as potentially posing unacceptable risks to lower trophic level receptors, while lead was identified in surface soil as potentially posing unacceptable risks for upper trophic level receptors. However, only one subsurface soil sample contained concentrations of these analytes greater than base background levels. Thus, subsurface soil contamination is considered isolated and limited in extent and does not warrant remedial action. Additionally, antimony is not considered to bioaccumulate; therefore, risk to birds and mammals from exposure to antimony is not considered to be significant. Consequently, lead in surface soil is considered to pose an unacceptable risk to ecological receptors.

2.4.3 Site-specific Remediation Goals

In order to address the potentially unacceptable risks from exposure to lead and antimony in surface soil, site-specific risk-based clean-up levels, or SRGs, were developed. The SRGs were developed for the most conservative potential future use of the site which would be residential. As discussed above, the HHRS identified antimony and lead in surface soil as posing potential unacceptable risks to human receptors. Therefore, human health risk-based SRGs were calculated for antimony and lead in surface soil for future residential land use.

The potential unacceptable risks associated with antimony are based on non-carcinogenic effects as antimony is not considered a carcinogen. Therefore, the residential use-based SRG for antimony was calculated for a child resident based on a target non-cancer hazard. The SRG was calculated using standard default EPA exposure assumptions, and the calculation is shown in Table B-1 in **Appendix B**. The antimony SRG was calculated for target non-cancer hazard indices of 0.1, 0.5, and 1; however, as antimony was the only non-carcinogenic constituent posing a potential unacceptable risk, the SRG was based on the target hazard index of 1.

The lead SRG was calculated using the Integrated Exposure Uptake Biokinetic (IEUBK) model for the residential child and the results are shown in Table B-2 in **Appendix B**. The IEUBK model was run using all of the default model values except for the default groundwater concentration. The maximum detected concentration of lead in groundwater at UXO-14 (0.98 μg/L from sample MR14-TW01-9D) was used as the groundwater input concentration.

The calculated SRGs for antimony and lead that would allow for unlimited use/unrestricted exposure (UU/UE) are as shown in **Table 2-11** below. Background values are also provided for comparison.

TABLE 2-11
Site Specific Remediation Goals

Contaminant	MCIEAST-MCB CAMLEJ Background Threshold Value – Undeveloped Sand	Site Specific Remediation Goal
Antimony	0.972	31
Lead	20.9	443

Notes:
Values in milligrams per kilogram (mg/kg)

Additionally, lead in surface soil is considered to pose an unacceptable risk to ecological receptors. Application of the SRG for lead would be protective of ecological receptors for several reasons. First, the primary risk posed by these analytes is to lower and upper trophic level receptors exposed to surface soils from 0 to 1 foot bgs. The excavation would remove all soils between 0 and 1 foot bgs that contained lead and antimony at concentrations greater than the human health SRGs. This area would then be backfilled with clean fill and the exposure pathway to subsurface soils would be eliminated. Second, the average concentrations of lead located outside the proposed

excavation area are not likely to pose risk to birds and mammals foraging in the area. The average residual lead concentration (178 mg/kg) is less than the concentration considered to pose no risk to populations based on a lowest observed adverse effect level for the most sensitive species evaluated, the mourning dove (338 mg/kg). While some elevated lead concentrations may remain in soils outside the proposed excavation area, they are isolated and very limited in extent and would not be considered to pose a risk to populations of ecological receptors. **Figure 2-1** depicts the highest overall concentrations of lead and antimony in surface soil that were detected during the PA/SI and ESI field investigations. **Figure 2-5** depicts two separate removal areas, which represent exceedances of the SRGs at the UXO-14 Former Indoor Pistol Range. These are the areas that will be addressed during the NTCRA.

2.5 Determination of Removal Area

Based on analytical data and the results of the HHRS and ERS, an area of the site was identified as posing unacceptable risks to humans and the environment due to concentrations of lead and/or antimony in surface soil. This area identified for action under this NTCRA is based on exceedances of the SRGs. A total of 0.16 acre (roughly 7,000 square feet) of impacted surface soil to a depth of 1 foot bgs is recommended for action, as illustrated by the proposed removal action areas on **Figure 2-6**. The volume of soil is estimated to be approximately 260 cubic yards (yd^3). Confirmation samples will be collected at the limits of the removal area (side walls and base, if applicable) for any removal action involving excavation to confirm that the full extent of impacted soil is addressed.

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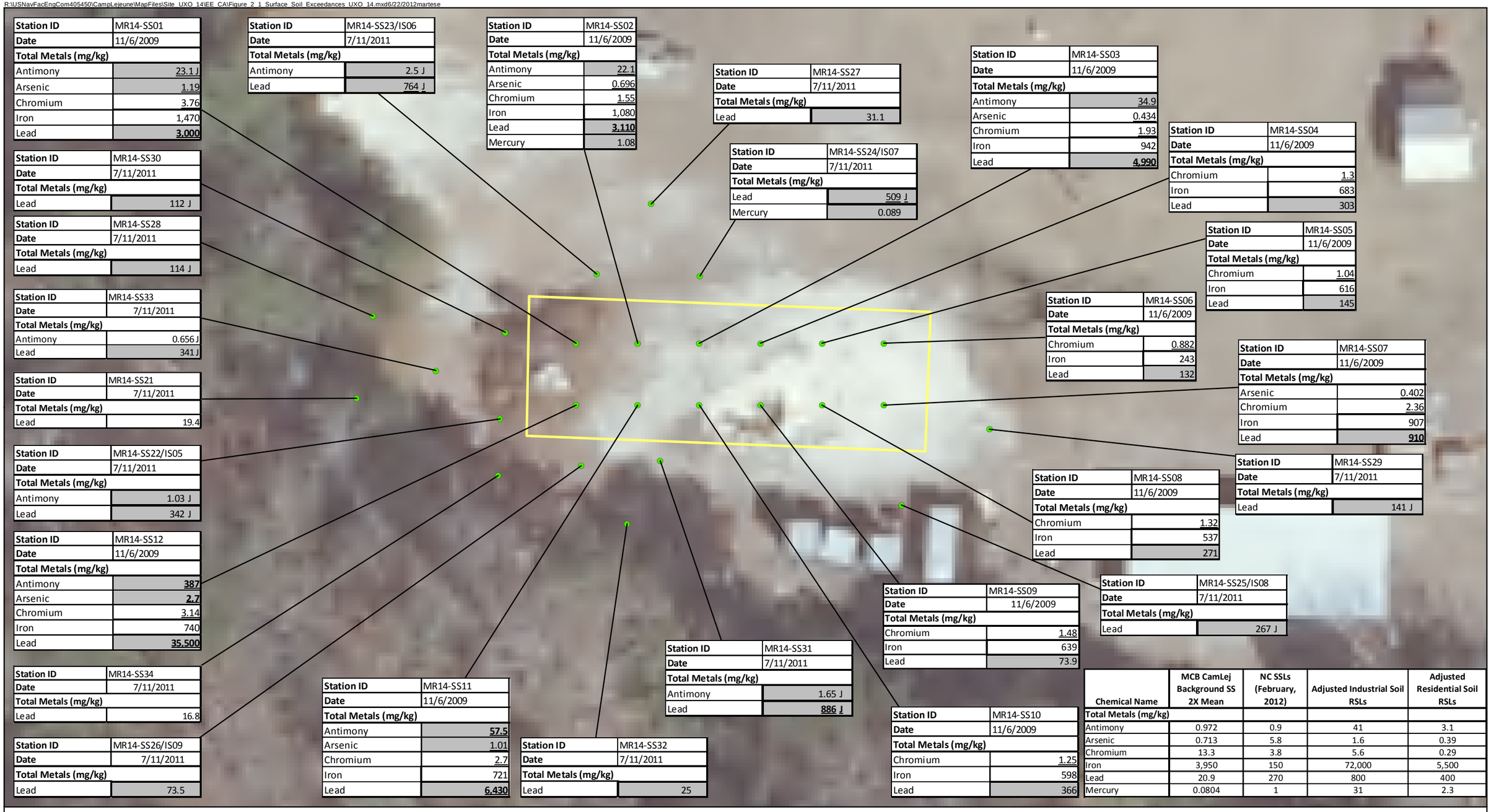

Station ID	MR14-SS01
Date	11/6/2009
Total Metals (mg/kg)	
Antimony	23.1 J
Arsenic	1.19
Chromium	3.76
Iron	1,470
Lead	**3,000**

Station ID	MR14-SS23/IS06
Date	7/11/2011
Total Metals (mg/kg)	
Antimony	2.5 J
Lead	764 J

Station ID	MR14-SS02
Date	11/6/2009
Total Metals (mg/kg)	
Antimony	22.1
Arsenic	0.696
Chromium	1.55
Iron	1,080
Lead	**3,110**
Mercury	1.08

Station ID	MR14-SS27
Date	7/11/2011
Total Metals (mg/kg)	
Lead	31.1

Station ID	MR14-SS03
Date	11/6/2009
Total Metals (mg/kg)	
Antimony	34.9
Arsenic	0.434
Chromium	1.93
Iron	942
Lead	**4,990**

Station ID	MR14-SS04
Date	11/6/2009
Total Metals (mg/kg)	
Chromium	1.3
Iron	683
Lead	303

Station ID	MR14-SS24/IS07
Date	7/11/2011
Total Metals (mg/kg)	
Lead	509 J
Mercury	0.089

Station ID	MR14-SS30
Date	7/11/2011
Total Metals (mg/kg)	
Lead	112 J

Station ID	MR14-SS28
Date	7/11/2011
Total Metals (mg/kg)	
Lead	114 J

Station ID	MR14-SS33
Date	7/11/2011
Total Metals (mg/kg)	
Antimony	0.656 J
Lead	341 J

Station ID	MR14-SS05
Date	11/6/2009
Total Metals (mg/kg)	
Chromium	1.04
Iron	616
Lead	145

Station ID	MR14-SS06
Date	11/6/2009
Total Metals (mg/kg)	
Chromium	0.882
Iron	243
Lead	132

Station ID	MR14-SS21
Date	7/11/2011
Total Metals (mg/kg)	
Lead	19.4

Station ID	MR14-SS07
Date	11/6/2009
Total Metals (mg/kg)	
Arsenic	0.402
Chromium	2.36
Iron	907
Lead	**910**

Station ID	MR14-SS22/IS05
Date	7/11/2011
Total Metals (mg/kg)	
Antimony	1.03 J
Lead	342 J

Station ID	MR14-SS29
Date	7/11/2011
Total Metals (mg/kg)	
Lead	141 J

Station ID	MR14-SS08
Date	11/6/2009
Total Metals (mg/kg)	
Chromium	1.32
Iron	537
Lead	271

Station ID	MR14-SS12
Date	11/6/2009
Total Metals (mg/kg)	
Antimony	**387**
Arsenic	**2.7**
Chromium	3.14
Iron	740
Lead	**35,500**

Station ID	MR14-SS09
Date	11/6/2009
Total Metals (mg/kg)	
Chromium	1.48
Iron	639
Lead	73.9

Station ID	MR14-SS25/IS08
Date	7/11/2011
Total Metals (mg/kg)	
Lead	267 J

Station ID	MR14-SS31
Date	7/11/2011
Total Metals (mg/kg)	
Antimony	1.65 J
Lead	**886 J**

Station ID	MR14-SS34
Date	7/11/2011
Total Metals (mg/kg)	
Lead	16.8

Station ID	MR14-SS11
Date	11/6/2009
Total Metals (mg/kg)	
Antimony	**57.5**
Arsenic	1.01
Chromium	2.7
Iron	721
Lead	**6,430**

Station ID	MR14-SS32
Date	7/11/2011
Total Metals (mg/kg)	
Lead	25

Station ID	MR14-SS10
Date	11/6/2009
Total Metals (mg/kg)	
Chromium	1.25
Iron	598
Lead	366

Station ID	MR14-SS26/IS09
Date	7/11/2011
Total Metals (mg/kg)	
Lead	73.5

Chemical Name	MCB CamLej Background SS 2X Mean	NC SSLs (February, 2012)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Total Metals (mg/kg)				
Antimony	0.972	0.9	41	3.1
Arsenic	0.713	5.8	1.6	0.39
Chromium	13.3	3.8	5.6	0.29
Iron	3,950	150	72,000	5,500
Lead	20.9	270	800	400
Mercury	0.0804	1	31	2.3

Legend

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

Notes:

-Shading indicates exceedance of two times the mean base background concentration

-Bold box indicates exceedance of NC SSL

-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

-J - Analyte present, value may or may not be accurate or precise

-mg/kg - Milligrams per kilogram

N

0 12.5 25 50 Feet

1 inch = 25 feet

Figure 2-1
Surface Soil Exceedances
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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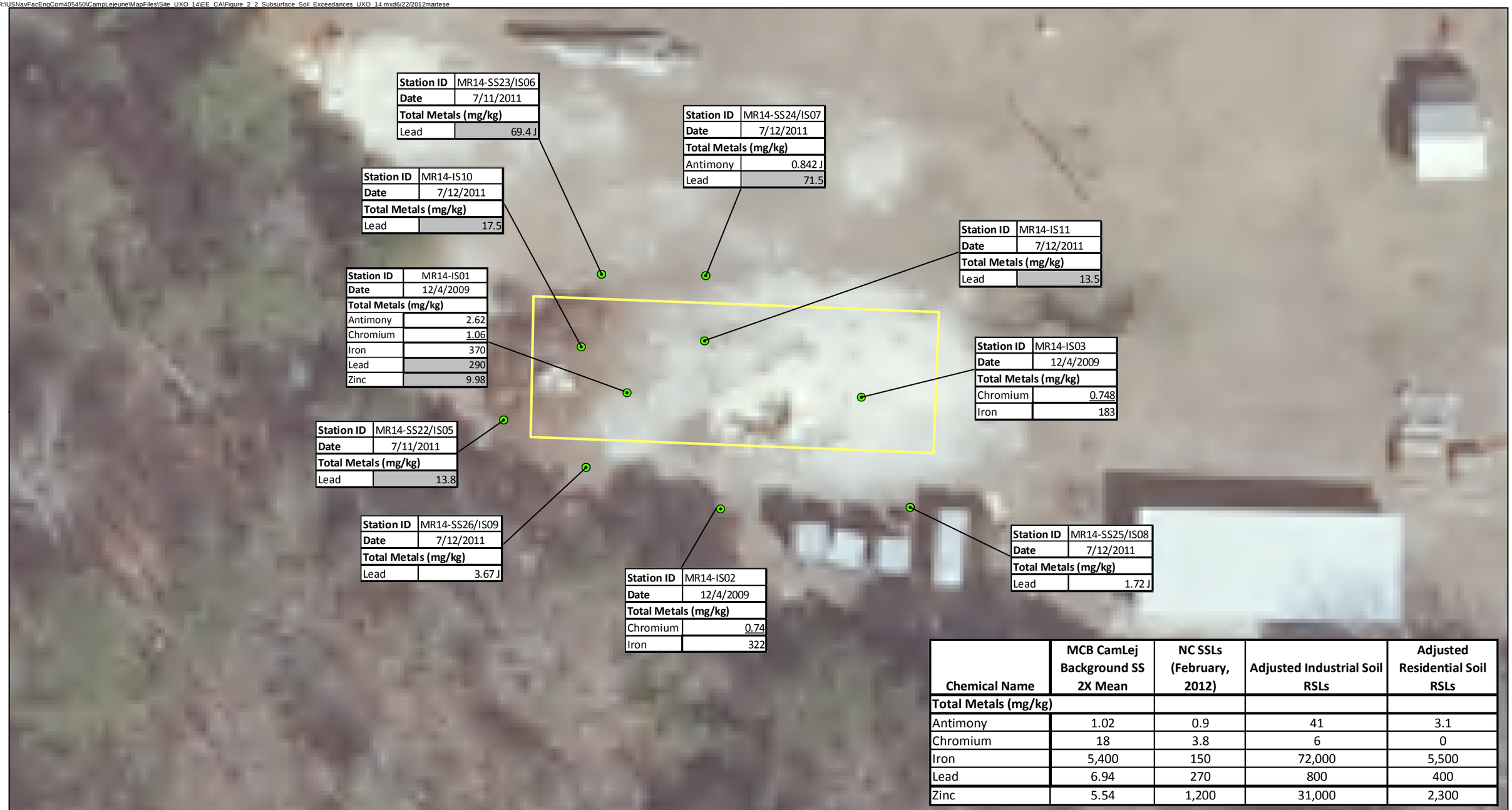

Chemical Name	MCB CamLej Background SS 2X Mean	NC SSLs (February, 2012)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Total Metals (mg/kg)				
Antimony	1.02	0.9	41	3.1
Chromium	18	3.8	6	0
Iron	5,400	150	72,000	5,500
Lead	6.94	270	800	400
Zinc	5.54	1,200	31,000	2,300

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

Notes:
- Shading indicates exceedance of two times the mean base background concentration
- **Bold text indicates exceedance of Adjusted Industrial Soil RSLs**
- Bold box indicates exceedance of NC SSL
- Underline indicates exceedance of Adjusted Residential Soil RSLs
- 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

N

0 12.5 25 50 Feet

1 inch = 25 feet

Figure 2-2
Subsurface Soil Exceedances
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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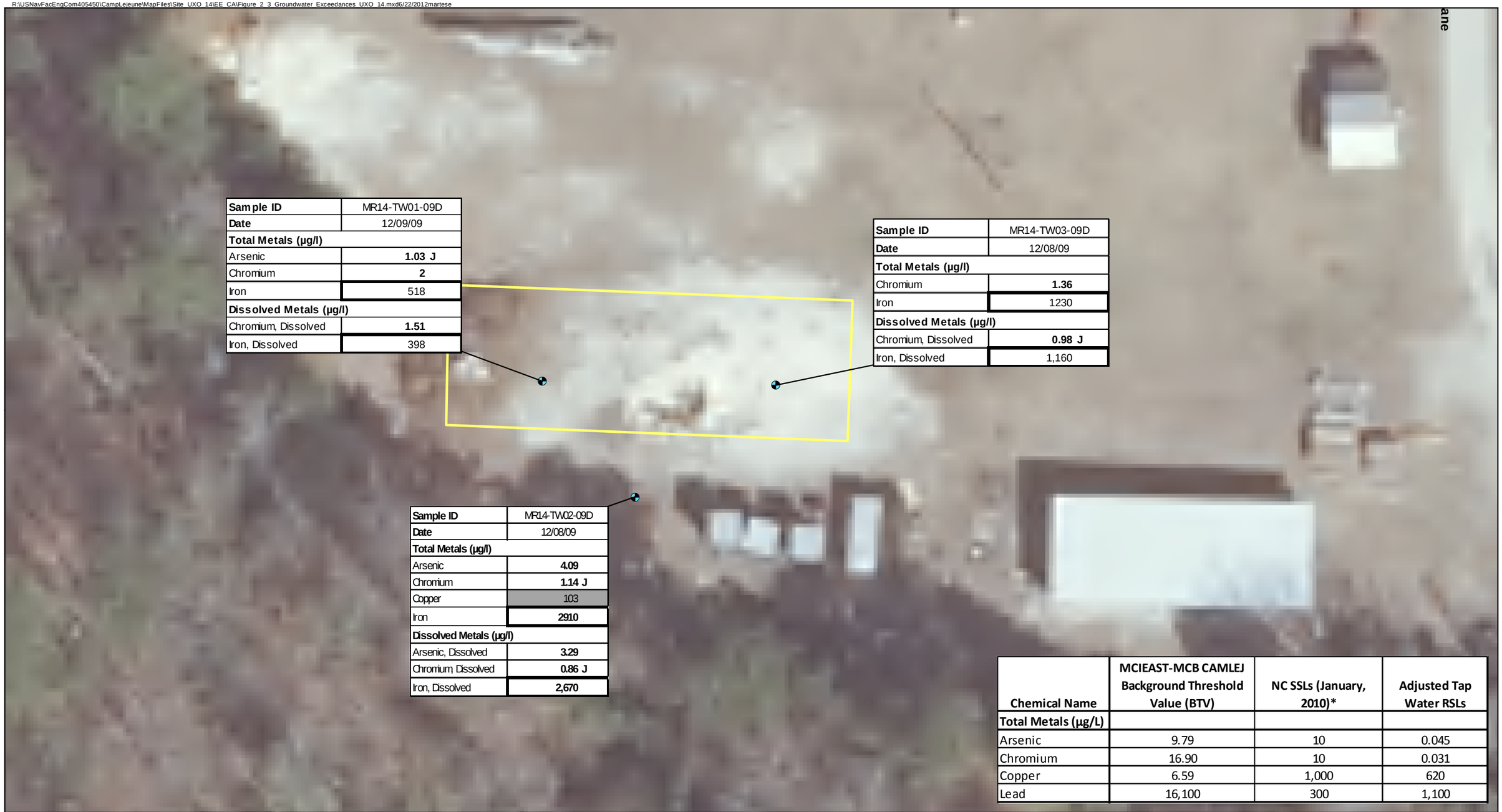

Sample ID	MR14-TW01-09D
Date	12/09/09
Total Metals (µg/l)	
Arsenic	**1.03 J**
Chromium	**2**
Iron	518
Dissolved Metals (µg/l)	
Chromium, Dissolved	**1.51**
Iron, Dissolved	398

Sample ID	MR14-TW03-09D
Date	12/08/09
Total Metals (µg/l)	
Chromium	**1.36**
Iron	1230
Dissolved Metals (µg/l)	
Chromium, Dissolved	**0.98 J**
Iron, Dissolved	1,160

Sample ID	MR14-TW02-09D
Date	12/08/09
Total Metals (µg/l)	
Arsenic	**4.09**
Chromium	**1.14 J**
Copper	103
Iron	**2910**
Dissolved Metals (µg/l)	
Arsenic, Dissolved	**3.29**
Chromium, Dissolved	**0.86 J**
Iron, Dissolved	**2,670**

Chemical Name	MCIEAST-MCB CAMLEJ Background Threshold Value (BTV)	NC SSLs (January, 2010)*	Adjusted Tap Water RSLs
Total Metals (µg/L)			
Arsenic	9.79	10	0.045
Chromium	16.90	10	0.031
Copper	6.59	1,000	620
Lead	16,100	300	1,100

Legend

- Temporary Well Location
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)

Notes:
- Shading indicates exceedance of BTV for surficial aquifer 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.
- µg/L - Micrograms per liter
- J - Analyte present, value may or may not be accurate or precise

N

0 12.5 25 50 Feet

1 inch = 25 feet

Figure 2-3
Groundwater Exceedances
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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Potential Source:
Firearms range

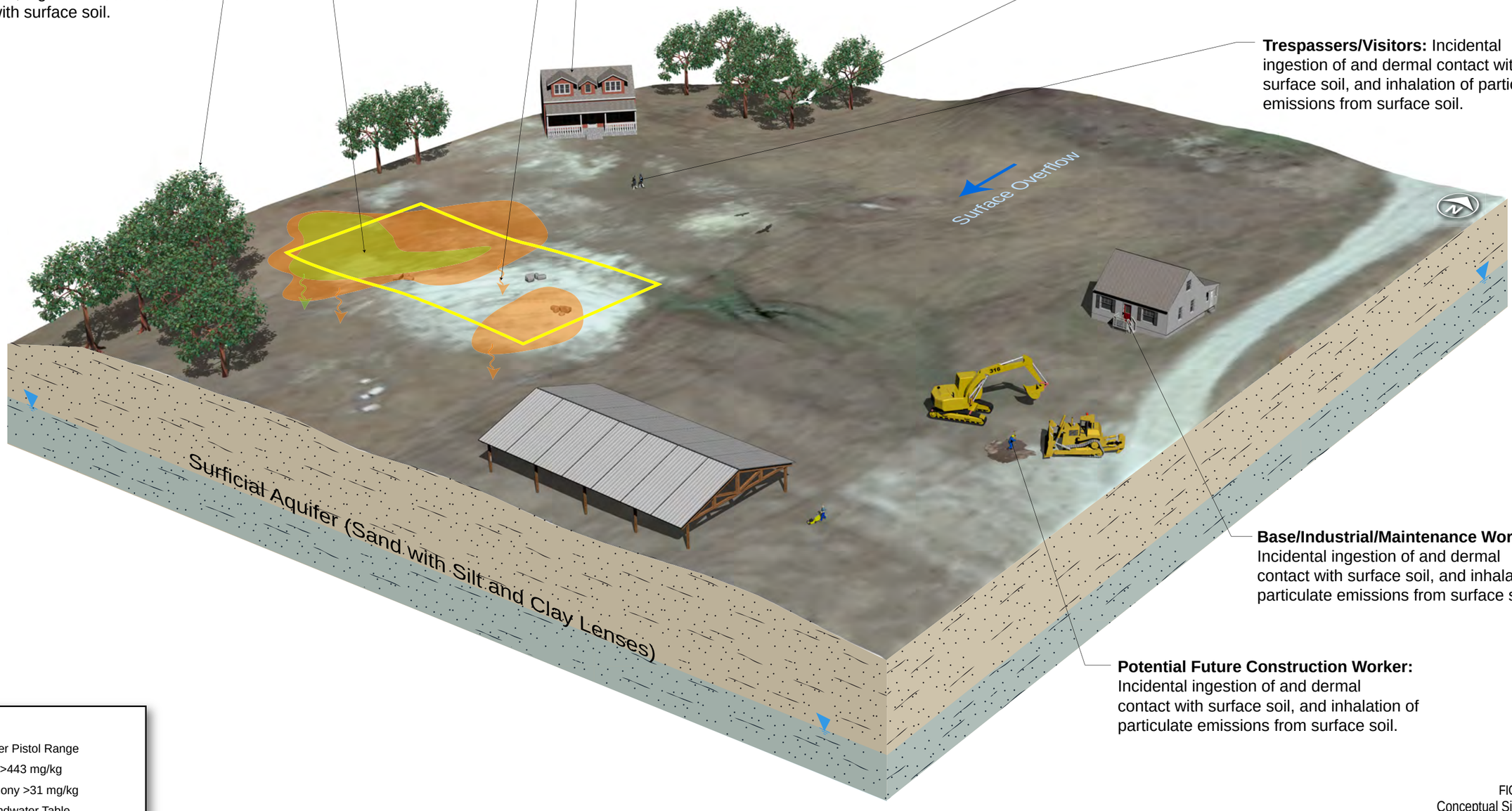
Potential Vertical Migration:
Contaminants may migrate to subsurface soil and leach to groundwater.

Terrestrial Flora and Invertebrates:
Direct contact with and root uptake from surface soil, ingestion of and direct contact with surface soil.

Potential Future Residents:
Incidental ingestion of and dermal contact with surface soil, and inhalation of particulate emissions from surface soil.

Terrestrial Birds and Mammals: Ingestion of and dermal contact with surface soil.

Trespassers/Visitors: Incidental ingestion of and dermal contact with surface soil, and inhalation of particulate emissions from surface soil.



Base/Industrial/Maintenance Workers:
Incidental ingestion of and dermal contact with surface soil, and inhalation of particulate emissions from surface soil.

Potential Future Construction Worker:
Incidental ingestion of and dermal contact with surface soil, and inhalation of particulate emissions from surface soil.

LEGEND

- Former Pistol Range
- Lead >443 mg/kg
- Antimony >31 mg/kg
- Groundwater Table
- Surface Water Flow Direction
- Surficial Aquifer
- Sand with Silt And Clay Lenses

FIGURE 2-4
Conceptual Site Model
Site UXO-14 - Former Indoor Pistol Range
MCIEAST-MCB CAMLEJ
North Carolina

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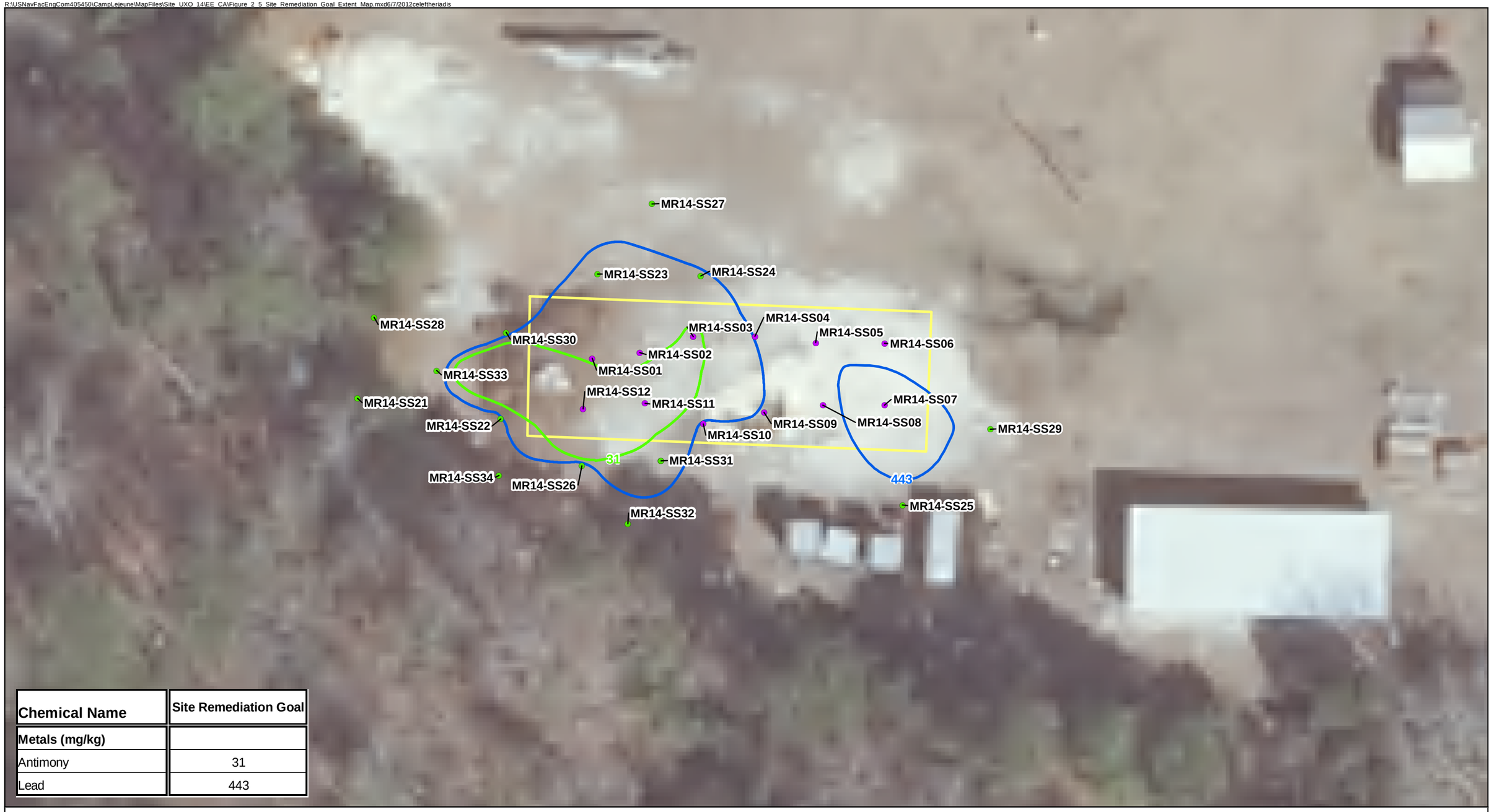

Chemical Name	Site Remediation Goal
Metals (mg/kg)	
Antimony	31
Lead	443

Legend
- 2011 Surface Soil
- 2009 Surface Soil
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)
- Lead > 443 mg/kg
- Antimony > 31 mg/kg

Notes:
mg/kg - Milligrams per kilogram
Concentration contours have been inferred between sampling locations.
Actual conditions may differ from those shown here.

N

0 12.5 25 Feet

1 inch = 25 feet

Figure 2-5
Site Remediation Goal Extent Map
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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Chemical Name	Site Remediation Goal
Metals (mg/kg)	
Antimony	31
Lead	443

Legend

- 2011 Surface Soil
- 2009 Surface Soil
- Proposed Removal Action Area
- Lead > 443 mg/kg
- Antimony > 31 mg/kg
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)

Notes:
mg/kg - Milligrams per kilogram
Concentration contours have been inferred between sampling locations.
Actual conditions may differ from those shown here.

N

0 12.5 25
Feet

1 inch = 25 feet

Figure 2-6
Proposed Removal Action Area
Site UXO-14 EE/CA
MCIEAST-MCB CAMLEJ
North Carolina

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SECTION 3

Identification of Removal Action Objectives

This section identifies the objectives for the NTCRA at the Former Indoor Pistol Range. The objectives for the proposed removal action area are based on the identified risks identified which were posed by exposure to lead and antimony in the surface soil.

The following are the removal action objectives (RAOs) for the NTCRA:

1. Prevent exposure to surface soils with lead and antimony concentrations exceeding the site-specific remediation goals.
2. Reduce the potential for COCs lead and antimony to migrate from surface soil to subsurface soil and groundwater.

3.1 Statutory Limits on Removal Actions

NCTRAs funded by the USEPA have a $2 million and a 12-month statutory limit pursuant to Section 104(c)(1) of CERCLA fund-financed removal actions, with statutory exemptions for emergencies and actions consistent with the removal action to be taken. This removal action will not be USEPA fund-financed; it will be financed by the Navy. The Defense Environmental Restoration Program (DERP) Manual does not limit the cost or duration of the removal action; however, cost-effectiveness is a recommended criterion for the evaluation of removal action alternatives.

3.2 Determination of Removal Action Scope

Potential risks have been identified in two areas around the footprint of the Former Indoor Pistol Range. The selected removal action is intended to be a corrective action implemented within the vicinity of the Former Indoor Pistol Range to reduce the amount of contaminant mass present, to the extent practicable, in order to minimize potential unacceptable risk to human health and the environment and reduce the potential for contaminant migration from soil to groundwater.

3.3 Determination of Removal Action Schedule

Implementation of the removal action is anticipated to require approximately 2 to 3 weeks based on which removal action is chosen. Factors that may affect the removal action schedule primarily relate to site conditions, requirements of the removal technologies, availability of vendors and supplies, MCIEAST-MCB CAMLEJ mission requirements, and inclement weather.

3.4 Applicable or Relevant and Appropriate Requirements

As required by Section 121 of CERCLA, removal actions carried out onsite under Section 104 or secured under Section 106 must attain the levels of standards of control for hazardous substances, pollutants, or contaminants specified by the applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws and state facility-siting laws unless waivers are obtained. The elements of the removal action, carried out offsite, are subject to all applicable regulations rather than ARARs. The requirements of CERCLA generally apply as a matter of law only to removal actions. However, as required by 40 CFR Section 300.415(j), ARARs will be identified and attained for removal actions to the extent practicable. The following three factors will be applied to determine whether the identification and attainment of ARARs is practicable in a particular removal situation:

1. Exigencies of the situation
2. Scope of the removal action
3. Effect of ARAR attainment on the statutory limits for removal action duration and cost

ARARs are identified by the USEPA as either being applicable to a situation or relevant and appropriate to it. These distinctions are critical to understanding the constraints imposed on response alternatives by environmental regulations other than CERCLA while operating onsite. The following definitions of ARARs are from the USEPA guidance (USEPA, 1988).

Applicable requirements, as defined in 40 CFR Section 300.5, means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, or contaminant, remedial action, location, or other circumstance at a CERCLA site.

"Relevant and appropriate requirements" are standards and environmental protection criteria of federal or state law that, although not "applicable" to a hazardous substance, pollutant, contaminant, action being taken, location, or other circumstance, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. The procedure to determine whether a requirement is relevant and appropriate is a two-step process. A requirement is "relevant" if it addresses problems or situations sufficiently similar to the circumstances of the proposed response action. A requirement is "appropriate" if it would also be well suited to the conditions of the site.

A requirement may be "relevant" to a particular situation but not "appropriate," given site-specific circumstances; such a requirement would not be an ARAR for the site. A requirement that is relevant and appropriate must be met as if it were applicable. Relevant and appropriate requirements that are more stringent than applicable requirements take precedence. However, more discretion is allowed in determining relevant and appropriate requirements than in determining applicable requirements.

"To-be-considereds" (TBCs) are non-promulgated advisories or guidance issued by federal or state government that are not legally binding and do not have the status of potential ARARs. TBCs are evaluated along with ARARs and may be implemented by USEPA when ARARs are not fully protective of human health and the environment.

Another factor in determining which response requirement must be met is whether the requirement is substantive or administrative. Onsite CERCLA response actions must meet substantive requirements of ARARs but not administrative requirements. This distinction applies to onsite actions only, as offsite response actions are subject to all applicable standards and regulations, including administrative requirements such as permits, rather than ARARs. Substantive requirements are those dealing directly with actions or with conditions in the environment. Administrative requirements implement the substantive requirements by prescribing procedures such as fees, permitting, and inspection that make substantive requirements effective.

Three classifications of requirements are defined by USEPA in the ARAR determination process: chemical-specific, location-specific, and action-specific. **Appendix C** contains the ARAR summary.

Chemical-specific ARARs are health- or risk-management-based numbers or methodologies that result in the establishment of numerical values for a given medium that would meet the NCP "threshold criterion" of overall protection of human health and the environment. These requirements generally set protective SRG concentrations for the COCs in the designated media, or set safe concentrations of discharge for response activity. Chemical-specific requirements are generally set for a single chemical or closely related group of chemicals and do not typically consider mixtures of chemicals. When chemical-specific requirements do not adequately protect human health or the environment, SRGs may be set below the TBC value.

Location-specific ARARs restrict response activities and media concentrations based on the characteristics of the surrounding environments. Location-specific ARARs may include restrictions on response actions within wetlands or floodplains, near locations of known endangered species, or on protected waterways.

Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances.

Not all potential ARARs identified in **Appendix C** apply to every remedial alternative. A discussion concerning which ARARs may apply to each specific response action is included in Section 5. The work plan for the selected alternative will provide additional detail on how the ARARs for that action will be met.

SECTION 4

Identification of Removal Action Alternatives

General removal actions that could be used to satisfy RAOs include institutional controls, removal, containment, treatment, and disposal. In accordance with USEPA guidance (1993), treatment technologies are more favorable than containment. Technologies with demonstrated effectiveness in significantly reducing lead and antimony mass or mobility in soil include:

- Excavation and backfill
- Soil stabilization (*in situ* and *ex situ*)

4.1 Technology Descriptions

The following is a short description of the technologies considered for further evaluation.

Excavation and Backfill

Excavation and backfill involves the excavation of the removal area using conventional earth-moving equipment. The area of excavation is typically backfilled to original grade with imported clean fill or excavated soil that meets the SRGs. Excavation and backfill allows site closure or reuse within a short time frame, without long-term environmental monitoring.

All excavated soil would require disposal sampling in accordance with Resource Conservation and Recovery Act (RCRA) disposal requirements. The results of waste sampling would determine the final designation of the excavated soil as hazardous or non-hazardous. Non-hazardous soil would be transported to a regional Subtitle D landfill facility for disposal. Hazardous soil would be transported to a permitted, RCRA Subtitle C treatment, storage, or disposal facility.

Additional activities associated with excavation and backfill include: site surveying and clearing, construction of appropriate erosion and sediment controls to prevent contaminants from leaving the site, dust control, confirmation sampling on the sidewalls and base of the excavation, and restoration of excavated areas.

Soil Stabilization

Soil stabilization is a process by which material within the identified removal area are mixed with a reagent that chemically binds and immobilizes lead and other metals, such as antimony, in soil (USEPA, 2005). Lead binds readily with inorganic salts such as phosphate or sulfate and forms less soluble compounds, such as lead phosphate and lead sulfate. Lead is least soluble (and thereby immobile) when the pH of soil is maintained between 6 and 9 (ITRC], 2003). A buffering compound, such as lime or manganese oxide, reduces the leachability of lead. Reagents are typically buffered phosphate, sulfate, hydroxide, or carbonate compounds. Known soil stabilization reagents include Apatite, EcoBond, EnviroBlend, and Portland cement. EnviroBlend was the reagent identified for cost estimating purposes and its product information is included in **Appendix D**. The reagent would be applied to the ground surface and mixed into the shallow subsurface (*in situ*). Conventional construction equipment can be used to apply and mix the reagent. Material treated and excavated would be managed in accordance with RCRA disposal requirements. Additional activities associated with soil stabilization include: site surveying and clearing, dust control construction of erosion and sediment controls to prevent contaminants from leaving the site, confirmation sampling, and restoration of excavated and/or disturbed areas.

4.2 Development of Removal Action Alternatives

Three alternatives have been developed, drawing on the technologies described in Section 4.1. A discussion of each alternative is provided as follows.

4.2.1 Alternative 1—No Action

Alternative 1 implies that no treatment or removal work would be done. The no action alternative is the baseline against which the effectiveness of other removal action alternatives is compared. The area would be left as it currently exists, leaving the impacted surface soil in place. Under this alternative, no controls or removal technologies would be implemented. CERCLA (Section 121(c)), as amended by SARA (1986), requires that the site be reviewed every 5 years since the impacted surface soil remains onsite.

4.2.2 Alternative 2—Excavation and Offsite Disposal

Alternative 2 involves the excavation of roughly 260 yd^3 of soil from the target removal area. Excavated soil would be transported offsite for treatment and disposal. The excavation would be backfilled, graded, and seeded to promote drainage.

Although it is assumed the soil will be classified as a characteristic hazardous waste for lead, waste disposal soil samples will be taken and analyzed to determine RCRA classification. Soil classified as hazardous would either be direct loaded into dump trucks or staged in roll-offs for transport to a permitted, RCRA Subtitle C treatment, storage, or disposal facility. Any non-hazardous material would be disposed of at an approved Subtitle D landfill. For costing purposes, offsite disposal of excavated material was assumed to require 27 roll-offs at 15 tons each.

Confirmation samples would be collected from the side walls and base of the excavation and analyzed for lead and antimony and compared to the SRGs to verify that the horizontal and vertical extent of the contamination was removed. For this evaluation, the excavation area is assumed to be divided into 30-foot by 30-foot grids. A base sample will be composited from four aliquots collected within each grid. If the grid is along a sidewall, a sidewall sample will be composited from four aliquots collected within each grid. This is expected to result in the analysis of seven confirmation samples in the westernmost removal area (three base, four sidewall) and five samples in the eastern removal area to the east (one base, four sidewall).

All excavated soils would be managed in accordance with RCRA disposal requirements. An estimated 390 tons of soil would be excavated; and based on a rule of thumb that one sample per 500 tons be analyzed for Toxicity Characteristic Leaching Procedure (TCLP), only one TCLP sample was assumed for costing purposes. However, the frequency of representative waste characterization sampling will ultimately be based on the sizes of the loads hauled for disposal and the requirements of the disposal facility. Samples for offsite disposal characterization will also be collected in accordance with the MCIEAST-MCB CAMLEJ Investigation and Remediation Waste Management Plan (CH2M HILL, 2011d).

The following components are also included in this alternative:

- Site survey of excavation boundary and utility location
- Construction of erosion and sediment controls
- Concrete and debris removal as non-hazardous waste prior to soil excavation
- Site restoration with grading, clean soil backfilling, and seeding

4.2.3 Alternative 3—*In Situ* Soil Stabilization with Excavation and Offsite Disposal

Alternative 3 involves *in situ* mixing of stabilization reagents to render the contaminated soil non-hazardous, followed by excavation of the treated material from the removal area. The stabilization reagents would be distributed across the removal area using a spreader truck, then tilled into the underlying soil to a depth of 1 foot bgs using conventional equipment. Approximately 270 yd^3 of stabilized material would then be excavated and managed as non-hazardous waste and transported offsite for disposal. The excavation will be backfilled, graded, and seeded to promote drainage.

For Alternative 3, the primary purpose for a stabilization reagent would be to minimize lead leaching as evaluated by the TCLP method. Since antimony is not included in characteristic waste, the EnviroMag reagent will be used to stabilize the lead within the removal area, at a dose of 4 percent by weight. Since the reagent does not have an activation time, once it is mixed into the soil the TCLP sample can be immediately collected in preparation for subsequent excavation.

All excavated and treated soils would be analyzed to determine if soil has been rendered non-hazardous waste, in accordance with RCRA disposal requirements. An estimated 410 tons of soil would be excavated; and based on a rule of thumb that one sample per 500 tons be analyzed for TCLP, only one TCLP sample was assumed for costing purposes. However, the frequency of representative waste characterization sampling will ultimately be based on the sizes of the loads hauled for disposal and the requirements of the disposal facility. Samples for offsite disposal characterization will also be collected in accordance with the MCIEAST-MCB CAMLEJ Investigation and Remediation Waste Management Plan (CH2M HILL, 2011d).

It is assumed that incorporation of the stabilization reagent will result in the characterization of all treated waste as non-hazardous. Non-hazardous material would either be direct loaded into dump trucks or staged in roll-offs for transport and disposal at an approved Subtitle D Landfill. If waste characterization indicates that excavated material remains hazardous, the material will be handled as such and disposed of according to RCRA hazardous waste requirements. For costing purposes, offsite disposal of excavated material was assumed to require 28 roll-offs at 15 tons each.

Confirmation samples would be collected from the side walls and base of the excavation and analyzed for COCs and compared to the SRGs to verify that the horizontal and vertical extent of the contamination was removed. For this evaluation, it is assumed the excavation area will be divided into 30-foot by 30-foot grids. A base sample will be composited from four aliquots collected within each grid. If the grid is along a sidewall, a sidewall sample will be composited from four aliquots collected within each grid. This is expected to result in analysis of seven confirmation samples within the larger removal area (three base, four sidewall) and five samples from the smaller removal area (one base, four sidewall).

The following components are also included in this alternative:

- Site survey of excavation boundary and utility location
- Construction of erosion and sediment controls
- Concrete and debris removal as non-hazardous waste prior to soil stabilization mixing and excavation
- Site restoration by grading, soil backfill, and seeding

SECTION 5

Detailed Analysis of Removal Action Alternatives

The alternatives analysis uses the three main evaluation criteria of effectiveness, implementability, and cost in accordance with the USEPA guidance (1993). Each evaluation criterion is described in **Table 5-1.** Anticipated ARARs are listed in **Appendix C** and a breakdown of anticipated costs for each alternative is included in **Appendix E**. Additionally, a sustainability assessment was conducted using SiteWise, a stand-alone tool that assesses the environmental footprint of a remedial alternative to compare the overall life-cycle environmental impacts of each remedy (Battelle, 2010). The sustainability assessment does not replace any of the nine criteria; however, it provides an additional comparison criterion that may allow options with a smaller environmental impact to be selected when all other criteria are met. The results using the sustainability analysis tool SiteWise for each alternative are included in **Appendix F**. **Table 5-2** summarizes the evaluation for each alternative.

TABLE 5-1
Evaluation Criteria

Effectiveness	
Protection of human health and the environment	The assessment describes how the action achieves and maintains protection of human health and the environment and achieves site-specific objectives both during and after implementation.
Compliance with ARARs	An alternative is assessed in terms of its compliance with ARARs, or if a waiver is required, how it is justified.
Short-term effectiveness	An action is assessed in terms of its effectiveness in protecting human health and the environment during the construction and implementation of a remedy before response action objectives have been met. The duration of time until the response objectives are met and the environmental impact of each alternative are also factored into this criterion.
Long-term effectiveness and permanence	An action is assessed in terms of its long-term effectiveness in maintaining protection of human health and the environment after response action objectives have been met. The magnitude of residual risk and adequacy and reliability of post-removal site controls are taken into consideration.
Reduction of toxicity, mobility, or volume through treatment	An action is assessed in terms of anticipated performance of the specific treatment technologies it employs. Factors such as volume of materials destroyed or treated, the degree of expected reductions, the degree to which treatment is irreversible, and the type and quantity of remaining residuals are taken into consideration.
Implementability	
Technical feasibility	The ability of the technology to implement the remedy is evaluated.
Administrative feasibility	The administrative feasibility factor evaluates requirements for permits, zoning variances, impacts on adjoining property, and the ability to impose institutional controls.
Availability of services and materials	The availability of offsite treatment, storage and disposal capacity, personnel, services and materials, and other resources necessary to implement the alternative will be evaluated.
State and community acceptance	The acceptability of an alternative to the state agency and the community is evaluated.
Cost	
Direct and indirect capital costs	Includes costs for construction, equipment and materials, analytical services, engineering and design, and permits and licenses.

TABLE 5-2

Summary of Alternative Evaluation

Evaluation Criteria	Alternative 1 No Action	Alternative 2 Excavation and Offsite Disposal	Alternative 3 *In Situ* Soil Stabilization with Excavation and Offsite Disposal
Effectiveness			
Overall protection of human health and the environment	Does not meet RAOs	Meets RAOs through removal of soil from the site.	Meets RAOs through removal of the soil from the site.
Compliance with ARARs	Does not trigger ARARs	Implementation would require compliance with location- and action-specific ARARs. Includes requirements relating to stormwater runoff, dust emissions, management of hazardous and non-hazardous waste, and onsite staging piles.	Implementation would require compliance with location- and action-specific ARARs. Includes requirements relating to stormwater runoff, dust emissions, management of non-hazardous waste, and onsite staging piles.
Long-term effectiveness and permanence	Not effective in the long-term.	All soil with COCs above RAOs would be removed from site. Residual site risk is acceptable.	All soil with COCs above RAOs would be removed from the site. Residual site risk is acceptable.
Reduction of toxicity, mobility, or volume through treatment	Does not reduce toxicity, mobility, and volume.	Reduces toxicity, mobility, and volume through soil removal. Contaminants are not destroyed, but rather moved to an appropriate permitted disposal facility.	Reduces toxicity, mobility, and volume through soil removal. Stabilization reduces lead mobility in soil. Contaminants are not destroyed, but rather moved to an appropriate permitted disposal facility.
Short-term effectiveness	Not effective in the short-term.	Potential risks to site workers and the nearby community due to construction activity and increased truck traffic. Potential dust emission issues associated with excavation may require engineering controls. Action would require 2 weeks in the field to complete. Potential environmental impact due to transportation of investigation-derived waste (IDW) to disposal facility.	Potential risks to site workers and the nearby community due to construction activity and increased truck traffic. Potential dust emission issues associated with excavation and reagent mixing may require engineering controls. Action would require up to 3 weeks in the field to complete. Potential environmental impact due to transportation of investigation-derived waste (IDW) to disposal facility.
Implementability			
Technical Feasibility	Feasible	Excavation is a standard and reliable technology. Monitoring the technical aspects is easily done.	Excavation and in situ stabilization are reliable technologies. Monitoring the technical aspects is easily done.
Administrative Feasibility	Feasible	Waste being disposed is considered hazardous and would require additional permitting.	Treated waste is non-hazardous, and additional permitting is not necessary for transport or disposal.
Availability of Services and Materials	Not applicable	Services and materials are readily available. Limited number of disposal facilities.	Services and materials are readily available.
State and Community Acceptance	Unlikely	To be determined	To be determined
Cost			
Capital Cost	**$0**	**$387,000**	**$296,000**

5.1 Alternative 1—No Action

Effectiveness

Alternative 1, No Action, implies that no work would be done; therefore, this alternative is not capable of meeting the RAOs presented in Section 3. Alternative 1 does not address or mitigate the potential identified risks to human health and the environment or reduce the potential for horizontal and vertical migration and would therefore not be effective in the long-term.

This alternative would not involve any construction or operation and maintenance (O&M) activities and, therefore, would not involve any short-term risks and would not trigger any action-specific or location-specific ARARs that control such activities and no treatment would be implemented to reduce toxicity, mobility, or volume.

Implementability

Alternative 1, No Action, does not have construction or monitoring components and is therefore technically and administratively feasible. There are no implementability concerns posed by this remedy. State and community acceptance of this alternative is unlikely.

Cost

There are no costs posed by Alternative 1, no action.

5.2 Alternative 2—Excavation and Offsite Disposal

Effectiveness

Alternative 2, Excavation with Offsite Disposal, is considered protective of human health and the environment. Through physical removal of the soil, Alternative 2 is suitable for bulk removal of lead- and antimony-impacted surface soil above SRGs. Alternative 2 will require 2 weeks of field work to achieve RAOs.

Alternative 2 would have to comply with ARARs. All location-specific ARARs presented in **Appendix C** are applicable to Alternative 2. Action-specific ARARs applicable to Alternative 2 include requirements relating to the management of stormwater runoff from land-disturbing activities, the management of fugitive dust emissions, and the management of hazardous and non-hazardous waste onsite. Chemical-specific ARARs to be considered include the Risk Assessment Guidance for Superfund (RAGS) for antimony and lead, as these criteria were evaluated to identify the target treatment area and will be considered during the removal action to determine the extent of treatment.

Alternative 2 is effective in the long-term, as soil with concentrations above the SRGs would be physically removed and long-term environmental monitoring and LUCs would not be necessary. However, contaminants are not destroyed, but rather moved to a permitted facility. Alternative 2 eliminates toxicity, mobility, and volume of lead and antimony from the site through removal, but not treatment.

Alternative 2 would raise overall site risk for the period during which the action took place. Risks to site workers and the nearby community would increase due to construction activity and truck traffic. Engineering controls would be implemented to control dust and sediment and erosion control and to facilitate stormwater management. There would be an increase in truck traffic transporting the soil offsite for disposal that could cause a greater risk of injury or accidents. The health and safety issues with Alternative 2 are due to dust emissions, lead and antimony exposure, and heavy equipment used for excavation.

Implementability

Alternative 2, Excavation with Offsite Disposal, is technically feasible and easily implementable. Shallow subsurface utilities in the treatment area may be relocated or abandoned. Monitoring the removal effectiveness is easily completed. Services and materials associated with implementation of Alternative 2 are standard and readily available; however, there are a limited number of disposal facilities. State acceptance of this alternative is subject

to review. Community acceptance of this alternative is unknown and would be determined during the public comment period.

Cost

Alternative 2, Excavation with Offsite Disposal, is estimated to cost $387,000 (a -30 percent/+50 percent range of $271,000 to $580,000). This is equivalent to $1,476 per yd^3. There are no O&M costs associated with this alternative.

5.3 Alternative 3—*In Situ* Soil Stabilization with Excavation and Offsite Disposal

Effectiveness

Alternative 3, *In Situ* Soil Stabilization with Excavation and Offsite Disposal, is protective of human health and the environment. Through physical removal of the soil, Alternative 3 is suitable for bulk removal of lead- and antimony-impacted surface soil above the SRGs. Alternative 3 would require up to 3 weeks of field work to achieve RAOs.

Alternative 3 would have to comply with ARARs. All location-specific ARARs presented in **Appendix C** are applicable to Alternative 3. Action-specific ARARs applicable to Alternative 3 include requirements relating to the management of stormwater runoff from land-disturbing activities, the management of fugitive dust emissions, and the management of non-hazardous waste onsite. Because soil will be treated prior to excavation, requirements associated with the management of hazardous waste onsite are not applicable. Chemical-specific ARARs to be considered include the RAGS for antimony and lead, as these criteria were evaluated to identify the target treatment area and will be considered during the removal action to determine the extent of treatment.

Alternative 3 is effective and protective in the long-term, as the soil would be physically removed. However, stabilization does not destroy contaminants, but rather it makes them less mobile and reduces toxicity, making them a non-hazardous waste. Alternative 3 eliminates toxicity, mobility, and volume of lead and antimony from the site through treatment. Long-term environmental monitoring and LUCs would not be necessary.

Alternative 3 would raise overall site risk for the period during which the action took place. Risks to site workers and the nearby community would increase due to construction activity. Engineering controls would be implemented for dust control, sediment and erosion control, and stormwater management. There would be an increase in truck traffic that could cause a greater risk of injury or accidents. The health and safety issues with Alternative 3 are due to dust emissions, lead and antimony exposure, and heavy equipment used for excavation.

Implementability

Alternative 3, *In Situ* Soil Stabilization with Excavation and Offsite Disposal, is technically feasible and easily monitored. Shallow subsurface utilities in the excavation area may be relocated or abandoned. Treated material would need to be transported offsite for disposal. Services and materials associated with implementation of Alternative 3 are readily available. State acceptance of this alternative is subject to review. Community acceptance of this alternative is unknown and would be determined during the public comment period.

Cost

Alternative 3, *In Situ* Soil Stabilization with Excavation and Offsite Disposal, is estimated to cost $296,000 (a -30 percent/+50 percent range of $208,000 to $445,000). This is equivalent to $1,132 per yd^3. There are no O&M costs associated with Alternative 3.

SECTION 6

Comparative Analysis of Removal Action Alternatives

In this section, the alternatives are directly compared to one another based on their effectiveness, ease of implementation, and cost. This analysis clarifies which alternative is preferable in each category. Alternative 1 is not considered protective of human health or the environment and does not achieve the RAOs of this EE/CA because contamination would remain in place without administrative controls. For these reasons, Alternative 1 is not analyzed in the following sections.

6.1 Effectiveness

6.1.1 Protection of Human Health and the Environment

Alternatives 2 and 3 can achieve the RAOs specified in Section 3. Alternative 2 (Excavation and Offsite Disposal) and Alternative 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) are similar in protectiveness because they each involve the complete excavation and offsite transport of impacted soil, mitigating risks to human health and ecological receptors at the site.

6.1.2 Compliance with ARARs and Other Criteria, Advisories, and Guidance

Alternatives 2 and 3 comply with all ARARs. The ARARs are summarized in **Appendix C**.

Action-Specific ARARs

Alternatives 2 and 3 would be implemented in compliance with requirements relating to the management of stormwater runoff from land-disturbing activities, the management of fugitive dust emissions, and the management of non-hazardous solid waste onsite. If Alternate Design Criteria for construction management techniques, best management practices for sediment and erosion controls, and stormwater management measures, as specified in 15A North Carolina Administrative Code (NCAC) 02H.1008(h), are utilized, then the substantive requirements included in that provision will be met and documented either in a work plan or design document. Administrative reviews are not required for actions taken under CERCLA. Requirements pertaining to the management of fugitive dust emissions beyond the facility boundary specified in 15A NCAC 02D.0540 (g) will be met. Land-disturbing activities are exempt due to the size of the site; however, since soil is contaminated, dust will be controlled to prevent spread beyond the site boundary.

The alternatives will additionally be implemented in compliance with requirements regarding onsite staging, since each of these alternatives involves excavating material for onsite storage within rolloffs until the proper permitting can be obtained and the waste can be shipped to an appropriate disposal facility. Storage includes mixing, sizing, blending, or other similar physical operations, so long as the action is intended to prepare the waste for subsequent management or treatment. The substantive requirements regarding design, operation, and closure of waste staging areas associated with a corrective action will be met. Administrative reviews are not required for CERCLA actions, and a permit will not be required.

Alternative 2 (Excavation and Offsite Disposal) and potentially Alternative 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) may involve the excavation of hazardous waste; therefore, these alternatives would need to be implemented in accordance with requirements regarding hazardous waste management in containers onsite.

Location-Specific ARARs

Location-specific ARARs are applicable to Alternatives 2 and 3 based on the location of the treatment area near a wetland, within the Atlantic Migratory Flyway, and within the coastal zone. Since the site is located in the Atlantic Migratory Flyway, if migratory birds, or their nests or eggs are identified at the site, operations will not destroy the birds, nests, or eggs. Additionally, activities at UXO-14 that will affect North Carolina's coastal zone will be consistent to the maximum extent practicable with North Carolina's enforceable policies. Activities performed on-site and in compliance with CERCLA are not subject to administrative review; however, the substantive requirements of making a consistency determination will be met. None of the alternatives presented include the discharge of dredged material in a wetland. Activities at the Former Indoor Pistol Range that will affect North Carolina's coastal zone will be consistent to the maximum extent practicable with North Carolina's enforceable policies. Activities performed onsite and in compliance with CERCLA are not subject to administrative review; however, substantive requirements of making a consistency determination will be met.

Chemical-Specific ARARs

Chemical-specific ARARs will be considered for each of the alternatives presented. Human health risk-based SRGs were developed for antimony and lead to identify the NTCRA area.

Because Alternatives 3 will require treatment of soil before disposal in accordance with land disposal restrictions, the soil would no longer contain hazardous waste and would meet the UTS. To determine if the treated soil meets the standards of 40 CFR 268.40, a sample of the waste will be tested.

6.1.3 Long-term Effectiveness and Permanence

Alternatives 2 (Excavation and Offsite Disposal) and 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) are effective in the long-term as there will be no residual risk at their completion, since contaminants would be physically removed from the site.

6.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) would reduce toxicity, mobility, and volume through treatment since the full volume of soil would require *in situ* stabilization that would prevent leaching of site COCs thereby allowing the excavated material to be disposed of offsite as a non-hazardous waste. Although Alternative 2 (Excavation and Offsite Disposal) does not include treatment, it would reduce toxicity, mobility, and volume since the full volume of soil would be excavated and disposed of offsite.

6.1.5 Short-term Effectiveness

Alternative 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) has the highest short-term risk to workers, the community, and the environment based on the additional risk due to the use of heavy equipment to mix the stabilization agent. Alternatives 2 (Excavation and Offsite Disposal) and 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) have similar risks due to increased truck traffic since the full volume of excavated material would be transported offsite; however, Alternative 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) has a significantly lower environmental impact due to significantly further distance required for transportation of hazardous IDW offsite for Alternative 2 (Excavation and Offsite Disposal). Alternative 2 (Excavation and Offsite Disposal) would require 2 weeks in the field to complete whereas Alternative 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) would require up to 3 weeks in the field to complete.

6.2 Implementability

Both Alternatives 2 (Excavation and Offsite Disposal) and 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) are easily implementable and both are proven and reliable technologies, with equipment and materials readily available. Additionally, for both alternatives, all impacted soil would be removed from the site so no future actions for soil are anticipated. Alternative 2 (Excavation and Offsite Disposal) would be the easiest to implement, since Alternative 3 (*In Situ* Soil Stabilization with Excavation and Offsite Disposal) would require the additional *in*

situ soil stabilization step. Alternative 2 (Excavation and Offsite Disposal) may require additional administrative activities (such as manifesting) and transportation of hazardous waste to a disposal facility that will accept hazardous waste.

6.3 Cost of Alternatives

The cost estimates for the alternatives are provided in **Appendix E** and summarized in **Table 6-1**. Alternative 1, No Action, has no cost and is thereby the least expensive. Alternative 3, *In Situ* Soil Stabilization with Excavation and Offsite Disposal, has the lowest cost for a remedial action at $296,000 or $1,132 per yd^3. Alternative 2, Excavation and Offsite Disposal, has the highest overall cost at $387,000 or $1,476 per yd^3, primarily due to the significantly higher disposal costs for hazardous waste. Neither Alternative 2 nor Alternative 3 have long-term O&M costs, thus the total present worth is equal to the total capital costs for each.

TABLE 6-1
Cost Estimates for Removal Action Alternatives

Alternative	Capital Costs	-30%/+50% Range[1]	Cost per yd^3
Alternative 1 - No Action	$0	$0	$0
Alternative 2 - Excavation and Offsite Disposal	$387,000	$271,000/$580,000	$1,476
Alternative 3 - *In Situ* Stabilization with Excavation and Offsite Disposal	$296,000	$208,000/$445,000	$1,132

Note:

[1]Costs presented herein are for comparison purposes on and are not a guarantee of fixed cost for the specific alternative. The cost estimate is accurate to -30 percent/+50 percent.

SECTION 7

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TABLE F-5

Alternative 3 - *In Situ* Soil Stabilization with Excavation and Offsite Disposal

UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	20.82	244	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.46	6	NA	1.7E-04	6.1E-06	3.5E-05	1.5E-05	2.2E-03
	Transportation-Equipment	1.90	25	NA	6.0E-04	1.1E-05	5.3E-05	9.0E-06	2.0E-03
	Equipment Use and Misc	0.26	5	0.0E+00	1.7E-03	3.9E-04	2.2E-04	4.0E-05	1.3E-02
	Residual Handling	19.51	293	NA	3.1E-02	1.4E-02	7.7E-02	6.9E-05	2.5E-04
	Sub-Total	42.95	573	0.00E+00	3.37E-02	1.48E-02	7.69E-02	1.33E-04	1.74E-02
Total		**42.9**	**572.7**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

NA - Not Applicable

GHG - Greenhouse Gases

Appendix A
Historical Data Tables

PA/SI Historical Data Tables (CH2M HILL, 2011a)

TABLE 4-1
Surface Soil Analytical Results
Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area)
PA/SI Report
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background SS 2X Mean**	**NCPSRGs (January, 2010)**	**Adjusted Industrial Soil RSLs**	**Adjusted Residential Soil RSLs**	MR14-SS01		MR14-SS02	MR14-SS03	MR14-SS04	MR14-SS05	MR14-SS06	MR14-SS07	MR14-SS08	MR14-SS09	MR14-SS10	MR14-SS11
Sample ID					MR14-SS01-09D	MR14-SS01D-09D	MR14-SS02-09D	MR14-SS03-09D	MR14-SS04-09D	MR14-SS05-09D	MR14-SS06-09D	MR14-SS07-09D	MR14-SS08-09D	MR14-SS09-09D	MR14-SS10-09D	MR14-SS11-09D
Sample Date					11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09
Chemical Name																
Semivolatile Organic Compounds (µg/kg)																
2-Methylnaphthalene	--	1,600	370,000	31,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzaldehyde	--	--	1,200,000	780,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	--	180	2,100	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b)fluoranthene	--	600	2,100	150	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(g,h,i)perylene	--	360,000	1,700,000	170,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	--	5,900	21,000	1,500	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	7,200	120,000	35,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	--	330,000	2,200,000	230,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Fluorene	--	56,000	2,200,000	230,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene	--	8.7	22,000	6,100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	--	210	18,000	3,600	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	--	31	9,000	3,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	--	57,000	17,000,000	1,700,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	--	220,000	1,700,000	170,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)																
Aluminum	5,487	--	99,000	7,700	1,590	1,760	869	856	662	744	551	821	963	1,380	1,060	1,080
Antimony	0.447	--	41	3.1	23.1 J	6.43 J	22.1	34.9	0.675 J	0.744 U	0.77 U	0.347 J	0.759 U	0.776 U	0.862	**57.5**
Arsenic	0.626	5.8	1.6	0.39	0.931	1.19	0.696	0.434	0.246 J	0.204 J	0.257 U	0.402	0.337	0.33	0.335	1.01
Barium	14.5	580	19,000	1,500	13.2	10.4	6.57	6.09	3.15	2.21	2.17	6.32	2.44	2.96	2.83	5.57
Beryllium	0.103	--	200	16	0.256 U	0.266 U	0.251 U	0.247 U	0.254 U	0.248 U	0.257 U	0.302 U	0.253 U	0.259 U	0.249 U	0.269 U
Calcium	6,360	--	--	--	390	550	1,350	474	127 J	53 J	200 J	203 J	253 U	1,080	97.7 J	4,960
Chromium	6.05	3.8	5.6	0.29	3.76	3.26	1.55	1.93	1.3	1.04	0.882	2.36	1.32	1.48	1.25	2.7
Cobalt	0.294	--	30	2.3	0.267 J	0.665 U	0.627 U	0.592 J	0.634 U	0.62 U	0.641 U	0.754 U	0.632 U	0.646 U	0.622 U	0.375 J
Copper	4.83	700	4,100	310	4.57	12.8	2.68	2.78	1.39	0.962	1.08	8.47	1.43	1.2	1.3	4.43
Iron	3,245	150	72,000	5,500	1,470	1,150	1,080	942	683	616	243	907	537	639	598	721
Lead	12.3	270	800	400	**3,000**	**1,250**	**3,110**	**4,990**	303	145	132	**910**	271	73.9	366	**6,430**
Magnesium	238	--	--	--	77.3 J	93.6 J	251 U	68.7 J	254 U	248 U	257 U	62.2	253 U	58.8 J	249 U	141 J
Manganese	13.7	65	2,300	180	21.2	18	13.1	8.78	5.09	4.89	3.69	13.5	9.04	6.92	8.51	18
Mercury	0.081	1	31	2.4	0.0486	0.052	1.08	0.0399	0.017	0.033 U	0.033 U	0.0301 J	0.0135 J	0.033 U	0.033 U	0.0688
Nickel	1.21	130	2,000	160	1.83	1.78	1.42	1.91	1.01	0.592	0.404 J	1.43	0.912	0.961	0.936	1.73
Potassium	116	--	--	--	74.9 J	82.4 J	251 U	247 U	254 U	248 U	257 U	302 U	253 U	259 U	249 U	82.9 J
Silver	0.14	3.4	510	39	0.0563 J	0.266 U	0.11 J	0.0506 J	0.254 U	0.248 U	0.257 U	0.302 U	0.253 U	0.259 U	0.249 U	0.195 J
Sodium	80.9	--	--	--	256 U	266 U	251 U	247 U	254 U	248 U	257 U	302 U	253 U	259 U	249 U	225 J
Vanadium	8.9	--	520	39	7.66	7.17	7.1	8.74	3.45	1.63	1.09	6.02	3.63	2.52	3.55	5.39
Zinc	10.8	1,200	31,000	2,400	65.3	57.7	43.8	62.1	19.6	15	16.6 J	61.4 J	24.2 J	12.9 J	18.8 J	47.2 J

Notes:

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 RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

R - Unreliable Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-1
Surface Soil Analytical Results
Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area)
PA/SI Report
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background SS 2X Mean**	**NCPSRGs (January, 2010)**	**Adjusted Industrial Soil RSLs**	**Adjusted Residential Soil RSLs**	MR14-SS12	MR14-SS13		MR14-SS14	MR14-SS15	MR14-SS16	MR14-SS17	MR14-SS18	MR14-SS19	MR14-SS20
Sample ID					MR14-SS12-09D	MR14-SS13-09D	MR14-SS13D-09D	MR14-SS14-09D	MR14-SS15-09D	MR14-SS16-09D	MR14-SS17-09D	MR14-SS18-09D	MR14-SS19-09D	MR14-SS20-09D
Sample Date					11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09	11/06/09
Chemical Name														
Semivolatile Organic Compounds (µg/kg)														
2-Methylnaphthalene	--	1,600	370,000	31,000	NA	11 U	11 U	11 U	12 U	12 U	12	1.6 J	3.3 J	11 J
Benzaldehyde	--	--	1,200,000	780,000	NA	260 R	270 R	250 R	270 R	280 R	94 J	92 J	270 R	110 J
Benzo(a)anthracene	--	180	2,100	150	NA	11 UJ	11 U	11 U	12 UJ	12 UJ	12 UJ	12 UJ	2.8 J	3.2 J
Benzo(b)fluoranthene	--	600	2,100	150	NA	11 U	11 U	11 U	12 U	12 U	18	4.7	7.3 J	13 U
Benzo(g,h,i)perylene	--	360,000	1,700,000	170,000	NA	11 U	11 U	11 U	12 U	12 U	7.2 J	12 U	2.6 J	13 U
Benzo(k)fluoranthene	--	5,900	21,000	1,500	NA	11 U	11 U	11 U	12 U	12 U	4.4 J	2.3	2.8 J	13 U
bis(2-Ethylhexyl)phthalate	--	7,200	120,000	35,000	NA	260 UJ	270 U	250 UJ	270 UJ	280 UJ	60 J	280 U	270 U	310 U
Fluoranthene	--	330,000	2,200,000	230,000	NA	1.8 J	2.5 J	1.5 J	4 J	6 J	11 J	4.7 J	5 J	7.2 J
Fluorene	--	56,000	2,200,000	230,000	NA	11 U	11 U	11 U	12 U	12 U	12 U	12 U	12 U	4 J
Hexachlorobutadiene	--	8.7	22,000	6,100	NA	11 U	11 U	11 U	12 U	12 U	12 U	12 U	12 U	4.3 J
Naphthalene	--	210	18,000	3,600	NA	11 U	11 U	11 U	12 U	12 U	10 J	12 U	12 U	11 J
Pentachlorophenol	--	31	9,000	3,000	NA	760 U	760 U	720 U	780 U	800 U	630 J	800 U	780 U	900 U
Phenanthrene	--	57,000	17,000,000	1,700,000	NA	11 U	11 U	11 U	12 U	12 U	20	3.3	5.3 J	9.4 J
Pyrene	--	220,000	1,700,000	170,000	NA	2 J	3 J	11 U	12 U	6.3 J	12 J	4.6 J	6.2 J	6.8 J
Total Metals (mg/kg)														
Aluminum	5,487	--	99,000	7,700	807	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	0.447	--	41	3.1	**387**	NA	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.626	5.8	1.6	0.39	**2.7**	NA	NA	NA	NA	NA	NA	NA	NA	NA
Barium	14.5	580	19,000	1,500	7.79	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	0.103	--	200	16	0.0503 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	6,360	--	--	--	405	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	6.05	3.8	5.6	0.29	3.14	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cobalt	0.294	--	30	2.3	0.314 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Copper	4.83	700	4,100	310	11.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Iron	3,245	150	72,000	5,500	740	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	12.3	270	800	400	**35,500**	NA	NA	NA	NA	NA	NA	NA	NA	NA
Magnesium	238	--	--	--	248 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	13.7	65	2,300	180	13	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mercury	0.081	1	31	2.4	0.0293 J	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	1.21	130	2,000	160	2.01	NA	NA	NA	NA	NA	NA	NA	NA	NA
Potassium	116	--	--	--	248 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	0.14	3.4	510	39	0.634	NA	NA	NA	NA	NA	NA	NA	NA	NA
Sodium	80.9	--	--	--	248 U	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	8.9	--	520	39	5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
Zinc	10.8	1,200	31,000	2,400	47.3 J	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

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 RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

R - Unreliable Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-2
Subsurface Soil Analytical Results
Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area)
PA/SI Report
MCB CamLej, North Carolina

Station ID	**Camp Lejeune Background SB 2X Mean**	**NCPSRGs (January, 2010)**	**Adjusted Industrial Soil RSLs**	**Adjusted Residential Soil RSLs**	MR14-IS01	MR14-IS02	MR14-IS03	MR14-IS04	
Sample ID					MR14-IS01-2-3-09D	MR14-IS02-2-3-09D	MR14-IS03-2-3-09D	MR14-IS04-4-5-09D	MR14-IS04D-4-5-09D
Sample Date					12/04/09	12/04/09	12/04/09	12/04/09	12/04/09
Chemical Name									
Semivolatile Organic Compounds (µg/kg)									
Benzaldehyde	--	--	1,200,000	780,000	280 U	280 U	290 U	540 J	520 J
Naphthalene	--	210	18,000	3,600	12 U	12 U	12 U	1.8 J	13 U
Total Metals (mg/kg)									
Aluminum	10,369	--	99,000	7,700	1,530	881 J	793	NA	NA
Antimony	0.36	--	41	3.1	2.62	0.889 U	0.913 U	NA	NA
Arsenic	2.12	5.8	1.6	0.39	0.208 J	0.195 J	0.304 U	NA	NA
Barium	16.6	580	19,000	1,500	2.49	1.78 J	1.44 J	NA	NA
Chromium	14.5	3.8	5.6	0.29	1.06	0.74	0.748	NA	NA
Copper	2.56	700	4,100	310	1.28	0.592 U	0.609 U	NA	NA
Iron	5,439	150	72,000	5,500	370	322	183	NA	NA
Lead	8.49	270	800	400	290	1.34	1.8	NA	NA
Manganese	9.25	65	2,300	180	3.29	2.81 J	1.54	NA	NA
Mercury	0.071	1	31	2.4	0.0342 J	0.0333 U	0.041 U	NA	NA
Nickel	2.27	130	2,000	160	0.43 J	0.368 J	0.357 J	NA	NA
Vanadium	17.2	--	520	39	1.28	1.2	0.799	NA	NA
Zinc	6.59	1,200	31,000	2,400	9.98	1.18 U	3.3	NA	NA

Notes:

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 RSLs

Underline indicates exceedance of Adjusted Residential Soil RSLs

RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

R - Unreliable Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

mg/kg - Milligrams per kilogram

µg/kg - Micrograms per kilogram

TABLE 4-3
Groundwater Analytical Results
Site UXO-14 Former Indoor Pistol Range and Gas Chamber (Rifle Range Area,
PA/SI Report
MCB CamLej, North Carolina

Station ID	Camp Lejeune Background GW 2X Mean	NCGWQS (January 2010) *	Adjusted Tap Water RSLs	MR14-IS01	MR14-IS02	MR14-IS03	MR14-IS04	
Sample ID				MR14-TW01-09D	MR14-TW02-09D	MR14-TW03-09D	MR14-TW04-09D	MR14-TW04D-09D
Sample Date				12/08/09	12/08/09	12/08/09	12/09/09	12/09/09
Chemical Name								
Semivolatile Organic Compounds (µg/l)								
4-Methylphenol	--	40	18	NA	NA	NA	1.7 J	1.6 J
Benzo(a)pyrene	--	0.005	0.003	NA	NA	NA	**0.07 J**	**0.07 J**
Benzo(g,h,i)perylene	--	200	110	NA	NA	NA	0.08 J	0.073 J
Dibenz(a,h)anthracene	--	0.005	0.003	NA	NA	NA	**0.078 J**	**0.074 J**
Indeno(1,2,3-cd)pyrene	--	0.05	0.03	NA	NA	NA	**0.069 J**	**0.071 J**
Total Metals (µg/l)								
Aluminum	1,886	--	3,700	246 J	175 J	293 J	NA	NA
Arsenic	5.77	10	0.045	**1.03 J**	**4.09**	1.25 U	NA	NA
Barium	86.2	700	730	8.48 J	63.6	46.9	NA	NA
Beryllium	0.308	--	7.3	1.25 U	0.254 J	1.25 U	NA	NA
Calcium	69,078	--	--	7,480	5,870	31,600	NA	NA
Chromium	3.13	10	0.043	**2**	**1.14 J**	**1.36**	NA	NA
Copper	2.76	1,000	150	1.49 J	103	2.5 U	NA	NA
Iron	5,999	300	2,600	518	**2,910**	1,230	NA	NA
Lead	2.8	15	--	0.975	0.75 U	0.75 U	NA	NA
Magnesium	6,363	--	--	437 J	1,170 J	1,500	NA	NA
Manganese	214	50	88	5.01 J	23.4 J	13.7 J	NA	NA
Nickel	7.97	100	73	0.851 J	1.23 J	2.5 U	NA	NA
Potassium	3,277	--	--	1,070 J	1,250 J	1,710 J	NA	NA
Sodium	22,508	--	--	13,600	8,000	12,100	NA	NA
Vanadium	4.72	--	18	3.12 U	1.88 J	2.2 J	NA	NA
Zinc	42.1	1,000	1,100	3.16 J	3.16 J	5 U	NA	NA
Dissolved Metals (µg/l)								
Aluminum, Dissolved	1,886	--	3,700	100 J	118 J	149 J	NA	NA
Arsenic, Dissolved	5.77	10	0.045	1.25 U	**3.29**	1.25 U	NA	NA
Barium, Dissolved	86.2	700	730	8.1 J	61.5	47.5	NA	NA
Calcium, Dissolved	69,078	--	--	7,220	5,550	32,600	NA	NA
Chromium, Dissolved	3.13	10	0.043	**1.51**	**0.86 J**	**0.98 J**	NA	NA
Copper, Dissolved	2.76	1,000	150	1.32 J	2.5 U	2.5 U	NA	NA
Iron, Dissolved	5,999	300	2,600	398	**2,670**	1,160	NA	NA
Lead, Dissolved	2.8	15	--	0.83	0.75 U	0.75 U	NA	NA
Magnesium, Dissolved	6,363	--	--	422 J	1,140 J	1,530	NA	NA
Manganese, Dissolved	214	50	88	5.53 J	22.8 J	13.4 J	NA	NA
Nickel, Dissolved	7.97	100	73	0.78 J	1.35 J	2.5 U	NA	NA
Potassium, Dissolved	3,277	--	--	1,060 J	1,260 J	1,750 J	NA	NA
Sodium, Dissolved	22,508	--	--	13,400	9,510	12,500	NA	NA
Vanadium, Dissolved	4.72	--	18	3.12 U	2.33 J	1.94 J	NA	NA

Notes:

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 NC2LGW where the MCL value is more conservative.

NA - Not analyzed

J - Analyte present, value may or may not be accurate or precise

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

µg/l - Micrograms per liter

ESI Historical Data Tables (CH2M HILL, 2011b)

TABLE 4-2
Surface Soil Analytical Results
Site UXO-14 Expanded SI Report
MCB CamLej, North Carolina

Station ID	MCB CamLej Background 2X Mean	CLEAN NC SSLs (June, 2011)	Adjusted Industrial Soil RSLs (June, 2011)	Adjusted Residential Soil RSLs (June, 2011)	MR14-SS21	MR14-SS22/IS05	MR14-SS23/IS06	MR14-SS24/IS07	MR14-SS25/IS08		MR14-SS26/IS09	MR14-SS27	MR14-SS28	MR14-SS29	MR14-SS30	MR14-SS31		MR14-SS32	MR14-SS33	MR14-SS34
Sample ID					MR14-SS21-11C	MR14-SS22-11C	MR14-SS23-11C	MR14-SS24-11C	MR14-SS25-11C	MR14-SS25D-11C	MR14-SS26-11C	MR14-SS27-11C	MR14-SS28-11C	MR14-SS29-11C	MR14-SS30-11C	MR14-SS31-11C	MR14-SS31D-11C	MR14-SS32-11C	MR14-SS33-11C	MR14-SS34-11C
Sample Date					07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11	07/11/11
Chemical Name																				
Total Metals (mg/kg)																				
Antimony	0.447	0.27	41	3.1	2.02 UJ	1.03 J	2.5 J	1.45 UJ	1.75 UJ	1.98 UJ	1.54 UJ	1.57 UJ	1.74 UJ	1.9 UJ	1.48 UJ	1.65 J	1.56 J	1.7 UJ	0.656 J	1.48 UJ
Lead	12.3	14	800	400	19.4	342 J	764 J	509 J	267 J	244 J	73.5	31.1	114 J	141 J	112 J	**886 J**	432 J	25	341 J	16.8
Mercury	0.081	0.1	31	2.3	0.0299 U	0.0286 U	0.056 J	0.089	0.0278 U	0.0291 U	0.0251 U	0.024 U	0.0224 J	0.0394 J	0.0249 U	0.0245 U	0.0257 U	0.0272 U	0.0291 U	0.0279 U

Notes:
ID = identification
mg/kg - milligrams per kilogram
NC SSL = North Carolina Soil Screening Level
RSL = Regional Screening Level
SS = surface soil
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 RSLs
Underline indicates exceedance of Adjusted Residential Soil RSLs
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate

TABLE 4-4
Subsurface Soil Analytical Results
Site UXO-14 Expanded SI Report
MCB CamLej, North Carolina

Station ID	MCB CamLej Background 2X Mean	CLEAN NC SSLs (June, 2011)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs	MR14-IS10	MR14-IS11	MR14-SS22/IS05	MR14-SS23/IS06		MR14-SS24/IS07	MR14-SS25/IS08	MR14-SS26/IS09
Sample ID					MR14-IS10-6_5-7_5-11C	MR14-IS11-5-6-11C	MR14-IS05-7-8-11C	MR14-IS06-6-7-11C	MR14-IS06D-6-7-11C	MR14-IS07-5-6-11C	MR14-IS08-4-5-11C	MR14-IS09-6-7-11C
Sample Date					07/12/11	07/12/11	07/11/11	07/11/11	07/11/11	07/12/11	07/12/11	07/12/11
Chemical Name												
Total Metals (mg/kg)												
Antimony	0.36	0.27	41	3.1	1.9 UJ	1.55 UJ	1.32 UJ	1.47 UJ	1.77 UJ	0.842 J	1.61 UJ	1.26 UJ
Lead	8.49	14	800	400	17.5	13.5	13.8	35.8 J	69.4 J	71.5	1.72 J	3.67 J
Mercury	0.071	0.1	31	2.3	0.0321 U	0.0292 U	0.0287 U	0.0303 U	0.0267 U	0.0302 U	0.0292 U	0.0303 U

Notes:
ID = Identification
NC SSL = North Carolina Soil Screening Level
RSL = Regional Screening Level
SB = subsurface
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 RSLs
Underline indicates exceedance of Adjusted Residential Soil RSLs
RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
J - Analyte present, value may or may not be accurate or precise
U - The material was analyzed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate

Appendix B
Human Health Risk Screening Tables

Table B-1

Human Health Risk-Based Site Remediation

Child Residential Scenario (Noncarcinogenic

Site UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

Chemical	Chronic Oral RfD (RfDo) (mg/kg-day)	Chronic Dermal RfD (RfDd) (mg/kg-day)	Chronic Inhalation RfC (RfC) (mg/m^3)	Target Organ	Absorption Factor (ABS)	An	Bn	Cn	Noncarcinogen SRG HQ = 0.1 (mg/kg)	HQ = 0.5 (mg/kg)	HQ = 1 (mg/kg)	SRG (mg/kg)	Target HQ[1] (mg/kg)
Antimony	4.0E-04	6.0E-05	NA	Longevitiy, Blood	1.0E-03	3.1E+01	1.7E+03	NA	3.1E+00	1.5E+01	3.1E+01	**3.1E+01**	1

Noncarcinogenic calculations:

$$\textbf{Soil SRG (mg/kg)} = \frac{1}{1/An + 1/Bn + 1/Cn}$$

$$\textbf{An (mg/kg)} = \frac{THQ \times BW \times ATn}{EF \times ED \times 1/RfDo \times IRS \times 1/10^6 \text{ mg/kg}}$$

$$\textbf{Bn (mg/kg)} = \frac{THQ \times BW \times ATn}{EF \times ED \times 1/RfDd \times SA \times AF \times ABS \times 1/10^6 \text{ mg/kg}}$$

$$\textbf{Cn (mg/kg)} = \frac{THQ \times ATn}{EF \times ED \times ET \times 1/RfC \times 1/PEF \times 1 \text{ day}/24 \text{ hours}}$$

EXPOSURE ASSUMPTIONS	
THQ - Target hazard quotient	0.1, 0.5, or 1
BW - Body weight (kilograms)	15
ATn - Averaging time for noncarcinogens (days)	2,190
ET - Exposure time (hours/day)	24
EF - Exposure frequency (days/year)	350
ED - Exposure duration (year)	6
IRS - Ingestion rate (mg/day)	200
SA - Skin surface area (cm^2)	2,800
AF - Soil to Skin Adherence Factor (mg/cm^2-day)	0.2
ABS - Absorption Factor (unitless)	chemical specific
PEF - Particulate Emission Factor (m^3/kg)	1.3E+09

1 Target HQ calculated so that total HQ for a target organ does not exceed 1.

NA - Not available/Not applicable

Table B-2

Summary of PRGs Calculated for Chemicals Of Concern

Site UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

Constituent	Residential PRGs (mg/kg)	Basis of PRG	PSRG, Residential (mg/kg)	PSRG, Industrial (mg/kg)	BTV (mg/kg)
Antimony	31	HI = 1	6.2	82	0.972
Lead	443	IEUBK	400	800	20.9

Notes:

BTV = MCIEAST-MCB CAMLEJ Background Threshold Value, undeveloped surface soil - sand

HI = Hazard Index

IEUBK = Integrated Exposure Update Biokinetic Model for Lead in Children. Model run using all default model values, except for maximum detected concentration of lead groundwater at UXO-14 of 0.98 ug/L, in sample MR14-TW01-09D

PRG = Preliminary Remediation Goal

PSRG = North Carolina Inactive Hazardous Sites Branch Preliminary Soil Remeditions Goals, February 2012

Appendix C
Applicable or Relevant and Appropriate Regulations

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
General Construction Standards — All Land-disturbing Activities (i.e., excavation, clearing, grading, etc.)			
Managing stormwater runoff from land-disturbing activities	Shall install erosion and sedimentation control devices and practices sufficient to retain the sediment generated by the land-disturbing activity within the boundaries of the tract during construction.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land – **relevant and appropriate to alternatives 2 and 3**	
	Erosion and sedimentation control plan must address the following basic control objectives: (1) Identify areas subject to severe erosion, and offsite areas especially vulnerable to damage from erosion and sedimentation. (2) Limit the size of the area exposed at any one time. (3) Limit exposure to the shortest feasible time. (4) Control surface water runoff originating upgrade of exposed areas (5) Plan and conduct land-disturbing activity so as to prevent offsite sedimentation damage. (6) Include measures to control velocity of storm water runoff to the point of discharge.		15A NCAC 4B.0106
	Erosion and sedimentation control measures, structures, and devices shall be planned, designed, and constructed to provide protection from the runoff of 10-year storm.	Land-disturbing activity (as defined in N.C.G.S. Ch. 113A-52) of more than 1 acre of land --**relevant and appropriate to alternatives 2 and 3**	15A NCAC 4B.0108
	Shall conduct activity so that the post-construction velocity of the 10-year storm runoff in the receiving watercourse to the discharge point does not exceed the parameters provided in this Rule.		15A NCAC 4B.0109

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
	Shall install and maintain all temporary and permanent erosion and sedimentation control measures.		15A NCAC 4B.0113
	Erosion and sedimentation control measures, structures, and devices with High Quality Water (HQW) zones shall be planned, designed and constructed to provide protection from the runoff of the 25 year storm.		15A NCAC 4B.0124(b)
	Provisions for ground cover sufficient to restrain erosion must be provided for any portion of the land-disturbing activity with 15 working days or 60 calendar days following completion of the construction or development, which period is shorter.		15A NCAC 4B.0124(e)
	Implement good construction management techniques, best management practices for sediment and erosion controls, and storm water management measures in accordance with 15A NCAC 02H .1008 to ensure storm water discharges are in compliance.	Development activity (otherwise requiring a stormwater permit) within one mile of and draining to waters classified as High Quality Waters (HQW) — **relevant and appropriate to alternatives 2 and 3**	15A NCAC 02H .1008 and the substantive provisions of NC General Permit CNCG 0100000
Air Quality Emission Control Standards			
Managing fugitive dust emissions: Implement methods (e.g. wetting dry soils) to control dust emissions that could travel beyond the facility boundary.	Shall not cause or allow fugitive dust emissions to cause or contribute to substantive complaints, or visible emissions in excess of that allowed under paragraph (e) of this Rule.	Activities within facility boundary that will generate fugitive dust emissions-- **relevant and appropriate to alternatives 2 and 3**	15A NCAC 02D .0540(a), (c), (f), and (g)

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
Waste Characterization and Storage — Primary Wastes (i.e., excavated contaminated soils)			
Characterization of solid waste (e.g. contaminated soil and drums)	Must determine if solid waste is hazardous waste or if waste is excluded under 40 CFR 261.4(b); and	Generation of solid waste as defined in 40 CFR 261.2 and which is not excluded under 40 CFR 261.4(A) -**applicable**	40 CFR 262.11(a)
	Must determine if waste is listed under 40 CFR Part 261; or		40 CFR 262.11(b)
	Must determine whether the waste is (characteristic waste) identified in subpart C of 40 CFR part 261 by either: (1) Testing the waste according to the methods set forth in subpart C of 40 CFR part 261. Or according to an equivalent method approved by the Administrator under 40 CFR 260.21; or (2) Applying knowledge of the hazard characteristic of the waste in light of the materials or processes used.	Generation of solid waste which is not excluded under 40 CFR 261.4(a) - **applicable**	40 CFR 262.11(c)
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous - **applicable**	40 CFR 262.11(d)
Storage of solid waste (e.g., contaminated soil)	All solid waste shall be stored in such a manner as to prevent the creation of a nuisance, insanitary conditions, or a potential public health hazard.	Generation of solid waste which is determined not to be hazardous-- **relevant and appropriate to alternatives 2 and 3**	15A NCAC 13B .0104(f)
	Containers for the storage of solid waste shall be maintained in such a manner as to prevent the creation of a nuisance or insanitary conditions. Containers that are broken or that otherwise fail to meet this rule shall be replaced with acceptable containers.		15A NCAC 13B .0104(e)

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	Generation of RCRA-hazardous waste for storage treatment or disposal – **applicable to alternative 2**	40 CFR 264.13(a)1)
Determinations for management of hazardous waste	Must determine each EPA Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 *et seq*.. *Note:* This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11 of this chapter.	Generation of hazardous waste for storage treatment or disposal – **applicable to alternative 2**	40 CFR 268.9(a)
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the characteristic waste	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST RORGS, POLYM of Section 268.42 Table 1) for storage, treatment or disposal – **applicable to alternative 2**	40 CFR 268.9(a)
	Must determine if the hazardous waste meets the treatment standards in 40 CFR 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste. *Note:* This determination can be made concurrently with the hazardous waste determination required in 40 CFR 262.11.	Generation of hazardous waste for storage treatment or disposal – **applicable to alternative 2**	40 CFR 268.7(a) 15A NCAC 13A.0112

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
Temporary Accumulation of hazardous waste in containers	A generator may accumulate hazardous waste at the facility for up to 90 days provided that: • Waste is placed in containers that comply with 40 CFR 265.171-173; and	Accumulation of RCRA hazardous Accumulation of RCRA hazardous waste on site as defined in 40 CFR 260.10 – **applicable to alternatives 2 and 3**	40 CFR 262.34(a) 15A NCAC 13A.0107(c) only as it incorporates the following citations: 40 CFR 262.34(a)(1)(i)
	• The date upon which accumulation begins must be clearly marked and visible for inspection on each container.		40 CFR 262.34(a)(2)
	• Container is marked with the words "hazardous waste"		40 CFR 262.34(a)(3)
Temporary on-site management of remediation waste in staging pile (e.g., excavated soils)	Staging pile must be designed to prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer as necessary to protect human health and the environment (e.g. use of liners, covers, run-off/run-on controls).	Management of remediation waste in a staging pile **– applicable to alternative 2**	15A NCAC 13A.0109(s) only as it incorporates 40 CFR 264.554(d)(1) (ii)
	In setting standards and design criteria must consider the following factors: • Length of time pile will be in operation; • Volumes of waste you intend to store in the pile; • Physical and chemical characteristics of the wastes to be stored in the unit; • Potential for releases from the unit; • Hydrogeological and other relevant environmental conditions at the facility that may influence the migration of any potential releases; and Potential for human and environmental exposure to potential releases from the unit.	Storage of remediation waste in a staging pile – **applicable to alternative 2**	15A NCAC 13A.0109(s) only as it incorporates 40 CFR 264.554(d)(2)(i) – (vi)

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
	Must be closed within 180 days after the operating term by removing or decontaminating all remediation waste, contaminated containment system components, and structures and equipment contaminated with waste and leachate.	Management of remediation waste in staging pile in *previously contaminated area* – **applicable to alternative 2**	15A NCAC 13A.0109(s) only as it incorporates 40 CFR 264.554(j)(1)
	Must decontaminate contaminated sub-soils in a manner that EPA determines will protect human and the environment.		15A NCAC 13A.0109(s) only as it incorporates 40 CFR 264.554(j)(2)
Waste Treatment and Disposal – Primary Wastes (excavated contaminated soils)			
Off-site disposal of solid waste (e.g., contaminated soil not considered RCRA hazardous waste)	Shall ensure that waste is disposed of at a site or facility which is permitted to receive the waste.	Generation of solid waste intended for off-site disposal – **relevant and appropriate**	15A NCAC 13B.0106(b)
Off-site disposal of RCRA hazardous waste in a land-based unit (i.e., landfill)	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste - **applicable**	40 CFR 268.40(a) 15A NCAC 13A.0112
	All underlying hazardous constituents [as defined in 40 CFR 268.2(i)] must meet the Universal Treatment Standards, found in 40 CFR 268.48 Table UTS prior to land disposal.	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class 1 nonhazardous injection well –**applicable**	40 CFR 268.40(e) 15A NCAC 13A.0112
Off-site disposal of RCRA-*hazardous waste soil* in a land-based unit (i.e. landfill)	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c) or Must be treated according to the UTSs [specified in 40 CFR 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA hazardous soils –**applicable**	40 CFR 268.49(b) 15A NCAC 13A.0112

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
Off-site disposal of RCRA *hazardous waste debris* in a land-based unit (i.e. landfill)	Must be treated prior to land disposal as provided in 40 CFR 268.45(a)(1)-(5) unless EPA determines under 40 CFR 261.3(f)(2) that the debris is no longer contaminated with hazardous waste or the debris is treated to the waste-specific treatment standards provided in 40 CFR 268.40 for the waste contaminating the debris.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA- hazardous debris **-applicable**	40 CFR 268.45(a) 15A NCAC 13A.0112
Transportation of Wastes			
Transportation of hazardous waste *on-site*	The generator manifesting requirements of 40 CFR 262.20-262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way -**applicable**	40 CFR 262.20(f) 15A NCAC 13A.0107
Transportation of hazardous waste *off-site*	Must comply with the generator standards of Part 262 including 40 CFR 262.20-23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect 262.32 for marking, Sect. 262.33 for placarding.	Preparation and initiation of shipment of hazardous waste off-site **–applicable**	40 CFR 262.10(h) 15A NCAC 13A.0107
Transportation of hazardous materials *off-site*	Shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR 171-180 related to marking, labeling, placarding, packaging, emergency response, etc.	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material **–applicable**	49 CFR 171.1(c)

TABLE C-1

Action-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Action	Requirements	Prerequisite	Citation
Off-site transportation of samples (i.e. contaminated soils)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when : • The sample is being transported to a laboratory for the purpose of testing; or • The sample is being transported back to the sample collector after testing. • The sample is being stored by sampled collector before transport to a lab for testing	Samples of solid waste or a sample of water, soil for purpose of conducting testing to determine its characteristics or composition - **applicable**	40 CFR 261.4(d)(1)(i)-(iii) 15A NCAC 13A.0106
	In order to qualify for the exemption in paragraphs (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: • Comply with U.S. DOT, U.S. Postal Service, or any other applicable shipping requirements • Assure that the information provided in (1) thru (5) of this section accompanies the sample. • Package the sample so that it does not leak, spill, or vaporize from its packaging.		40 CFR 261.4(d)(2)(i)(A) and (B) 15A NCAC 13A.0106

ARAR = applicable or relevant and appropriate requirement
CFR = *Code of Federal Regulations*
CWA = Clean Water Act of 1972
DEACT = deactivation
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
HMR = Hazardous Materials Regulations
HMTA = Materials Transportation Act
LDR = Land Disposal Restrictions
NPDES = National Pollutant Discharge Elimination System
POTW = Publically Owned Treatment Works
RCRA = Resource Conservation and Recovery Act of 1976
TCLP = Toxicity Characteristic Leaching Procedure
UTS = Universal Treatment Standard

TABLE C-2

Location-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCIEAST-MCB CAMLEJ, North Carolina

Location	Requirements	Prerequisite	Citation
Within the Atlantic Migratory Flyway	Protects almost all species of native birds in the United States from unregulated taking.	Any activity taking place within a migratory flyway - **applicable for alternatives 1, 2, and 3**	Migratory Bird Treaty Act, 16 USC 703
Within the coastal zone	Federal activities must be consistent with, to the maximum extent practicable, State coastal zone management programs. Federal agencies must comply with the consistency requirements of 15 CFR § 930.	Wetland, flood plain, estuary, beach, dune, barrier island, coral reef, and fish and wildlife and their habitat, within the coastal zone – **applicable for alternatives 1, 2, and 3**	15 CFR 930.33(a)(1), (a)(2), (b); .35(a), (b); .36(a)

TABLE C-3

Chemical-Specific Applicable or Relevant and Appropriate Requirements

Engineering Evaluation/Cost Assessment

UXO-014 Former Indoor Pistol Range

MCB CamLej, North Carolina

Media	Requirements	Prerequisite	Citation
Soil	U.S. Environmental Protection Agency (EPA) Risk Assessment Guidance for Superfund (RAGS). Chemical concentrations corresponding to fixed levels of human health risk (i.e., a hazard quotient of 1, or a lifetime cancer risk of $10^{-6,}$ whichever occurs at a lower concentration).	Assessment of potential human health risks - **to be considered for alternatives 1, 2, and 3.**	Risk Assessment Guidance for Superfund (RAGS) - USEPA Tables only as they apply to lead (443 mg/kg) and antimony (31 mg/kg).
	Disposal of a RCRA hazardous-waste in a land-based unit if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted hazardous soils - **Applicable for alternatives 2 and 3.**	40 CFR 268.40(a) as it applies to lead. The Universal Treatment Standard for lead is 0.75 mg/L by TCLP.
	All underlying hazardous constituents [as defined in 40 CFR 268.2(i)] must meet the Universal Treatment Standards, found in 40 CFR 268.48 Table UTS prior to land disposal.	Land disposal of restricted RCRA characteristic wastes (D001-D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well - **Applicable for alternatives 2 and 3.**	15A NCAC 13A.0112(c) only as it incorporates 40 CFR 268.40(e).

Appendix D
EnviroBlend Product Information

WHAT IS EnviroBlend®?

EnviroBlend® is a family of treatment chemicals, custom-blended to render metal-bearing wastes non-hazardous in both industrial wastes and contaminated soils. Applying EnviroBlend products to metals impacted materials produces stable metal compounds and reduces the leaching of metals in laboratory testing required by the US Environmental Protection Agency (EPA) to determine whether a waste is hazardous or non-hazardous.

EnviroBlend® HISTORY

The EnviroBlend® chemistry was originally developed in the mid-1980's for stabilizing lead and cadmium contaminated waste produced in the foundry industry. The chemistry was initially a buffered phosphate; a combination of magnesium oxide (MgO) and phosphate in varying ratios.

Premier Chemicals, LLC has been selling EnviroBlend® to the foundry industry for more than 20 years. Additionally, EnviroBlend® is regularly sold for remedial soil stabilization applications, such as Superfund or Brownfields sites.

CHEMISTRY

Metals Stabilization:

The original EnviroBlend® formulation used in many metals applications is a mixture of magnesium oxide and calcium phosphate. The buffering capacity of the magnesium oxide serves to keep pH at a level where metals are the most stable. In addition, the phosphate component binds with certain metals (i.e. lead) and creates insoluble compounds that are stable in the environment. This dual treatment approach is very effective for many metals of concern. The ratio of mag/phos is dependent upon the waste stream. For example, a strong buffering reagent is more important in cadmium treatment than the phosphate component; a high magnesium blend/straight magnesium is the best choice in this situation. On the contrary, an extremely high pH waste like foundry inoculation dust can be mostly composed of lime. Adding a high alkaline product is counter-productive, whereas a very high phosphate blend would be effective.

For most heavy metals, regulating pH of the environment is the key to controlling the leachability of metals. As such, EnviroBlend® offers several product options that are composed of magnesium oxide compounds and are proven to be highly effective at stabilizing heavy metals waste streams. These chemistries include our industry leading EnviroMag® and EnviroBlend® CS reagents that provide superior stabilization of heavy metals and are very cost effective to use.

Other metals, such as arsenic and hexavalent chromium, require a more innovative combination of treatment agents where pH adjustment alone will not suffice. For example, one of our products EnviroBlend® HX, an iron salt, will reduce hexavalent chromium to trivalent chromium, a more stable form of the metal.

We are also commonly faced with contaminated waste streams with multiple metals issues. For situations like these, we use an outside laboratory to conduct extensive testing on the waste in order to find a site-specific chemical treatment. We also use these facilities for treatment dosage testing and general assessment of waste samples.

Acid Gas Reduction:
Some EnviroBlend® clients have to focus on eliminating acid gas emissions from waste streams, such as sulfur dioxide (SO_2). Premier has developed specialized blends for these customers that satisfy treatment regulations for metals, plus reduces their emissions of acid gas. We do this by adding hydrated lime and/or sodium bicarbonate to our EnviroBlend® reagents, creating a single product that can address both issues at once.

Mechanical Stabilization/Odor Reduction:
EnviroBlend® products have been used at landfills and remedial projects around the country to increase soil stability. Working specific products in to the soil matrix has shown to increase mechanical and compaction strength, while maintaining workable soil. This is essential for sites that will see reuse and require moving or grading of soils post-treatment.

Currently, EnviroBlend manufactures two products targeted for dewatering and strengthening soils. Additionally, these products can also reduce odors as well and/or prevent them from being emitted as well. Testing at landfills and in saturated soils has shown these products can significantly reduce odors as measured with an Odor Intensity test (OIT). These same products have, in some instances, been mixed with clay or other reagents to enhance the odor reduction capability.

Dioxin/Furan Treatment:
The addition of powdered activated carbon has been added to EnviroBlend® products to reduce mercury and dioxin/furan in emissions.

REGULATORY REQUIREMENTS

General EPA Requirements:
The US Environmental Protection Agency (EPA) has developed an analytical test to determine what is considered “hazardous” versus “non-hazardous”. For heavy metals, the hazardous-non-hazardous threshold is dependent on the leachability of the metal in a test called the Toxicity Characteristic Leaching Procedure (TCLP).

The TCLP test is the most frequently required EPA test when dealing with metals; it is used to simulate leaching in a municipal landfill over 100 years. The test involves representative samples of contaminated waste being tumbled in acid for 18 hours and analyzing the results. For example, the leaching limit for lead is 5.0 mg/L and the limit for cadmium is <1.0 mg/L.

There are additional EPA leaching tests that are more stringent and are usually associated with remedial site work. The more stringent Synthetic Precipitation Leaching Procedure (SPLP) simulates the effect of acid rain on a landfill for 100 years , while the most stringent testing procedure, Multiple Extraction Procedure (MEP), attempts to simulate 1,000 years in a leaching environment. EnviroBlend® chemistries work to reduce metals leaching in every test.

Avoiding the Generation of a Hazardous Waste
One of the major benefits of using EnviroBlend® is that an industrial user, such as a foundry, can add EnviroBlend® “in-line” during waste production. If the user adds EnviroBlend®

stabilization reagents to the waste after it is generated – they will be required to apply for a hazardous waste generator permit, a very expensive and very time consuming process. However, by adding EnviroBlend® during the process that generates the waste, the waste is exempt from these EPA regulations - waste exits the process already treated and is handled as a non-hazardous waste stream.

PRODUCT INFORMATION

EnviroBlend® is a dry product available in a milled powder (200 mesh sizing) or granular form (30 mesh sizing). Most foundries and other industrial users order EnviroBlend® in milled form. Remedial applications usually require EnviroBlend® in a granular form since it is less dusty and easier to mix homogeneously with soil on site. EnviroBlend products are currently being produced at 10 different locations in the US in 50 lb. bags, 2000 lb. supersacks and in bulk pneumatic and/or dump trucks. In some cases, with rail-spur access, EnviroBlend can provide product directly to a location in railcars.

EnviroBlend has the industry expertise and experience to provide site and product information and recommendations, and can assist with, or conduct in house, treatability studies to determine an appropriate product for your application. EnviroBlend has multiple products typically used for specific metals and sites, but as every site or facility is different we will work with you and tailor a blend for your application to maximize treatment and cost efficiency.

MARKETS

EnviroBlend® has become a common treatment method for numerous waste streams from a variety of different sources.

Fixed-Base:

Currently, EnviroBlend® is sold to over 70 fixed-base facilities around the country. Any facility that regularly produces hazardous material (i.e. furnace bag house dust, slag, etc.) and needs to treat on a daily basis is considered a fixed-base customer. Some of our fixed-base applications include: foundry operations (i.e. iron, steel, aluminum, brass, copper), steel mill waste, battery manufacturing and recycling, water and sludge treatment, primary and secondary smelting, incinerator ash, scrap processing and recycling, and permitted TSDF's (transport, storage and disposal facilities). The EnviroBlend® chemicals are mixed within a process stream with emission control dust, various system sands, filter cake, slag or sludge to stabilize heavy metals, generally before a hazardous waste is generated.

Remedial:

EnviroBlend® has treated more than 650 remedial waste streams in the United States. These are typically one-time remediation sites with a finite amount of waste that needs to be treated, such as: Superfund sites, Brownfields, Voluntary Cleanup Program (VCP) sites, recycling and scrap yards, shooting ranges, scrap yards, mining and mine tailings sites and many others.

COMPETITION

EnviroBlend® competition falls into two categories, trade products and specialty chemicals.

Lime (CaO), Portland cement, lime-kiln dust, and cement kiln dust are all commonly available products that can be used to increase the pH of the waste stream and generally assist in making metals more stable. Wastes treated with these products will sometimes pass the initial TCLP test but will fail when placed in certain disposal situations, due to lime's capacity to dramatically increase pH to levels of 12 or higher. The most common waste metal is lead,

which is amphoteric - leachable at high and low pH values. Treatment with lime-based products may make lead become dangerously mobile. On the contrary, the MgO in EnviroBlend® keeps the maximum pH of the treated waste stream at approximately 10.5.

There are also specialty chemistries offered in the marketplace that compete with EnviroBlend®. However EnviroBlend® is typically the most reliable, effective, and cost efficient product, which translates into a lower overall cost per treated ton of waste.

MATERIAL SAFETY DATA SHEET

PREMIER CHEMICALS

MSDS No.: EB Standard Coarse
Date Prepared: 11/09
This Revision:

Phone: PREMIER CHEMICALS: 1-800-227-4287
CHEMTREC, 24-Hr Emergency Assistance: 1-800-424-9300

SECTION 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Material / Product Name(s): **EnviroBlend® Standard Coarse**
CAS Number: Mixture
Chemical Family: Inorganic - Mineral
General Use: A varying blend of magnesium oxide and calcium phosphates. Mix ratio depends on customer requirements and may vary from 1-99. Product used for metal containing waste stabilization.
Manufacturer / Supplier: PREMIER CHEMICALS, LLC
300 Barr Harbor
Suite 250
West Conshohocken, PA 19428-2998

SECTION 2. INGREDIENTS / COMPOSITION

Ingredient name:	CAS Number:	Percent:	IARC/NTP/OSHA:	Exposure Limits:
Nonhazardous Ingredients: A variable blend of magnesium oxide and calcium phosphates	1309-48-4 7758-23-8 7758-87-4	99-100	No	Nuisance Particulate OSHA PEL:TWA 15mg/m^3;respirable: 5mg/m^3. ACGIH TLV:TWA Total dust:10mg/m^3; respirable dust: 5mg/m^3.
Phosphoric Acid	7664-38-2	0 - 1	No	OSHA PEL:TWA 1.0mg/m^3; STEL 3.0mg/m^3 as mist.
Quartz*	14808-60-7	<1	Yes	ACGIH TLV:TWA respirable quartz 0.05mg/m^3.

***Quartz.** Product may contain a trace of quartz, a polymorph of crystalline silica, which is classified by IARC as a "Known Human Carcinogen - Group 1." NTP lists respirable crystalline silica amongst substances which may "reasonably be anticipated to be carcinogens".

SECTION 3. HAZARDS IDENTIFICATION

HMIS

HEALTH HAZARD	1 - SLIGHT
FLAMMABILITY HAZARD	0 - MINIMAL
REACTIVITY HAZARD	1 - SLIGHT
PERSONAL PROTECTION	B - Glasses, Gloves

EMERGENCY OVERVIEW:
Tan to gray coarse material. Blends high in magnesium oxide will react with water generating some heat. Not a fire or spill hazard. Low toxicity. Dust is classified as a "nuisance particulate not otherwise regulated".

Target Organs: Chronic overexposure may cause lung damage.
Primary route(s) of entry: Inhalation
Acute effects: Excessive exposure to airborne particulate may cause eye and upper respiratory irritation.
Chronic effects: Product dust is classified as a "nuisance particulate, not otherwise regulated" as specified by ACGIH and OSHA. The excessive, long-term inhalation of mineral dusts may contribute to the development of industrial bronchitis, reduced breathing capacity, and may lead to the increased susceptibility to lung disease.

HAZARD IDENTIFICATION continued from page 1

Signs & symptoms of overexposure:

Eye contact: Particulate is a physical eye irritant.

Skin contact: Low toxicity by skin contact.

Inhalation: Chronic overexposure by inhalation of airborne particulate may irritate upper respiratory system as well as the throat.

Ingestion: An unlikely route of exposure. If ingested in sufficient quantity, may cause gastrointestinal disturbances. Symptoms may include irritation, nausea, vomiting and diarrhea.

SECTION 4. FIRST AID MEASURES

Eye contact: Flush eyes, including under the eyelids, with large amounts of water. If irritation persists, seek medical attention.

Skin contact: Wash affected areas with mild soap and water.

Inhalation: Remove victim to fresh air. If not breathing, give artificial respiration. Get immediate medical attention.

Ingestion: Ingestion is an unlikely route of exposure. If ingested in sufficient quantity and victim is conscious, give 1-2 glasses of water or milk. Never give anything by mouth to an unconscious person. Leave decision to induce vomiting to qualified medical personnel, since particles may be aspirated into the lungs. Seek immediate medical attention.

SECTION 5. FIRE FIGHTING MEASURES

NFPA code: Flammability: 0, **Health:** 0, **Reactivity:** 1, **Special:** 0.

Flash point: Not Combustible

Unusual Fire Hazard / Extinguishing Media: Product will react with water generating some heat. Use sufficient water to dissipate any excessive heat buildup.

Hazardous Decomposition Products: None

Firefighting Instructions: Firefighters should wear NIOSH-approved, positive pressure, self-contained breathing apparatus and full protective clothing when appropriate.

SECTION 6. ACCIDENTAL RELEASE MEASURES

Spill procedures: Product is not harmful to the environment. Carefully, clean up and place spilled material into a suitable container, being careful to avoid creating excessive dust. If conditions warrant, clean up personnel should wear approved respiratory protection, gloves, and goggles to prevent irritation from contact and/or inhalation.

SECTION 7. HANDLING AND STORAGE

Storage: Store in dry, protected storage. Do not allow water to get inside containers; reaction with water will cause product to swell, generate heat, and burst its container. Exposed and unprotected the product will absorb moisture from the air. Minimize dust generation during material handling and transfer.

SECTION 8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

Engineering controls: Provide sufficient ventilation, in both volume and air flow patterns to control mist/dust concentrations below allowable exposure limits.

Personal protective equipment: The use of eye protection, gloves and long sleeve clothing is recommended.

Respiration protection: Provide workers with NIOSH approved respirators in accordance with requirements of 29 CFR 1910.134 for level of exposure incurred.

Hygienic Practices: Avoid contact with skin eyes and clothing. After handling this product, wash hands before eating or drinking.

SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance: A grayish-brown granular; odorless.
Boiling Point: Not Applicable **Specific Gravity (g/cc):** Mixture
Melting Point: >3800°F (>2100°C) **% Volatile by volume:** 0
Water Solubility: Slight <1% **Evaporation rate:** Not Applicable
pH (10% aqueous slurry): 2.5-10 (depending on blend ratio)
Bulk Density (lbs./cu.ft.): 45-70 (depending on blend ratio)

SECTION 10. STABILITY AND REACTIVITY

Hazardous Polymerization: Will not occur
Chemical Incompatibilities: The magnesium oxide component is soluble in aqueous acids generating heat and steam; violent reaction or ignition with interhalogens (e.g., bromine pentifluoride; chlorine trifluoride). Incandescent reaction with phosphorus pentachloride. Will react with water generating some heat.
Hazardous Decomposition Products: None

SECTION 11. TOXICOLOGICAL INFORMATION

Magnesium Oxide CAS #1309-48-4 Toxic and Hazard Review: low toxicity - a nutrient and/or dietary supplement food additive. THERAP CAT: antacid. (Sax) an experimental tumorigen. Inhalation of fume (not MgO dust particular) produced upon decomposition of magnesium compounds can produce a febrile reaction and leukocytosis in humans.

TOXICITY DATA: ihl-hmn TCLo:400mg/m^3; itr-ham TDLo:480 mg/kg/30w-I:ETA.

Triple Super Phosphate CAS#65996-95-4. Produced by addition of phosphoric acid to phosphate rock. Can contain up to 1% phosphoric acid. Phosphoric acid is cited as a human poison by unspecified route. Moderately toxic by ingestion and skin contact. A corrosive irritant to eyes, skin and mucous membranes and a systemic irritant by inhalation. (Please note, any free phosphoric acid in the triple super phosphate will react with the magnesium oxide component of the product forming a magnesium phosphate - the product will not contain any free acid.)

TOXICITY DATA: No LD_{50} or LC_{50} found for oral, dermal, or inhalation routes of administration.

Quartz CAS #14808-60-7. Toxic and Hazard Review (Sax): Experimental poison by inratracheal and intravenous routes. An experimental carcinogen, tumorigen, and neoplastigen. Human systemic effects by inhalation: cough, dyspnea, liver effects. Listed by IARC as a "Known Human Carcinogen" Group 1. Listed by NTP. No LD_{50} in RTECS. Inhalation human: TCLo 16 million particles per cubic centimeter per 8 hours per 17.9 Years-Intermittent:: Pulmonary system effects; Inhalation-human LCLo: 300 micrograms/m^3 per 10 years-intermittent liver. Other species toxicity data (NIOSH RTECS): intravenous-rat LDLo: 90mg/kg; intraperitoneal-rat LDLo: 20mg/kg; intravenous-mouse LDLo: 40mg/kg; intravenous-dog LDLo: 20mg/kg.

SECTION 12. ECOLOGICAL INFORMATION

Ecotoxicological / Chemical Fate Information:
No data available on any adverse effects of this material on the environment.

SECTION 13. DISPOSAL INFORMATION

Waste Management/Disposal: This product, as manufactured will not exhibit any characteristics of a hazardous waste, and is suitable for landfill disposal. Please be advised, however, that state and local requirements for waste disposal may be more restrictive or otherwise different from federal regulations. Consult state and local regulations regarding the proper disposal of this material. If, however, the product has been altered or contaminated with other hazardous materials, appropriate waste analysis may be necessary to determine the proper method for disposal. Waste characterization and disposal/treatment methods should be determined by a qualified environmental professional in accordance with applicable federal, state and local regulations.

SECTION 14. TRANSPORT INFORMATION

US Department of Transportation: Not regulated by DOT as a hazardous material. No hazard class, no label or placard required, no UN or NA number assigned.
Canadian TDG Hazard Class & Pin: Not regulated.

SECTION 15. REGULATORY INFORMATION

Product or components of mixture regulated under following lists:
SARA TITLE III:

Section 302: NO (Extremely Hazardous Substances)
Section 304: NO (Emergency Release)
Section 311: YES (*Community Right-to-Know*, MSDSs or List of Chemicals)
Section 312: YES (*Community Right-to-Know*, Inventory and Location, (Tier I/II))
Section 313: NO (Toxic Chemicals, Toxic Chemical Release Reporting, Form R)

TSCA: All substances in this product are listed in the Chemical Substance Inventory of the Toxic Substances Control Act.
CERCLA Hazardous Substance List, RQ: No
California Proposition 65: This product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive toxins.

SECTION 16. OTHER INFORMATION

ACRONYMS AND REFERENCES USED IN PREPARATION OF MSDS':

ACGIH:	American Conference of Governmental Industrial Hygienists
CAS#:	CAS Registration Number is an assigned number to identify a material. CAS stands for Chemical Abstracts Service.
CERCLA:	Comprehensive Environmental Response, Compensation & Liability Act
EPCRA:	Emergency Planning and Community Right-to-Know Act of 1986
HMIS™:	Hazardous Materials Identification System (National Paint & Coatings Association)
IARC:	International Agency for Research on Cancer
MSHA:	Mine Safety and Health Administration

mg/m^3:	Milligrams per cubic meter
NIOSH:	National Institute for Occupational Safety and Health
NFPA:	National Fire Protection Association
NTP:	National Toxicology Program
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit (OSHA)
REL:	Recommended Exposure Limit (OSHA)
SARA:	Superfund Amendments and Reauthorization Act
TITLE III:	Emergency Planning and Community Right-to-Know Act
Section 302:	Extremely Hazardous Substances
Section 304:	Emergency Release
Section 311:	*Community Right-to-Know*, MSDSs or List of Chemicals
Section 312:	*Community Right-to-Know*, Inventory and Location, (Tier I/II)
Section 313:	Toxic Chemicals, Toxic Chemical Release Reporting, Form R
TLV:	Threshold Limit Values (ACGIH)
TWA:	Time Weighted Average
29CFR1910.134:	OSHA Respiratory Protection Standard

REFERENCES:

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Kirk, R. and Othmer, D., Encyclopedia of Chemical Technology, Third Edition, Wiley-Interscience, New York, NY 1982.
Clansky, K.B., Suspect Chemicals Sourcebook, 1992-2nd Edition, Roytech Publications, Bethesda, Maryland.
Sax, N. Irving and Lewis, R.J. Hawley's Condensed Chemical Dictionary, Eleventh Ed., Van Nostrand Reinhold Co., Inc., NY
Manufacturers / Suppliers, Material Safety Data Sheets on Raw Materials Used
American National Standard for Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation, American National Standards Institute, Inc., 11 West 42nd St, New York, NY 10036.

Prepared/revised: Mark A. Shand November 13, 2009

Appendix E
Cost Estimates for Removal Action Alternatives

Alternative 2: Excavation with Offsite Disposal

Site: UXO-014 Former Indoor Pistol Range
Location: MCIEAST-MCB CAMLEJ, North Carolina
Phase: EE/CA
Date: 15-Jun-12

Description: Excavation of impacted surface soil to 1 foot below ground surface, with offsite disposal as hazardous waste

Description	Qty	Unit	Unit Cost	Total Cost	Notes
CAPITAL COSTS					
Construction Management Mob					
Mobilization and Setup	1	LS	$5,000	$5,000	Engineer's Estimate, based on recent procurement
SUBTOTAL				**$5,000**	
Site Preparation					
Survey of excavation boundary	1	Day	$1,750	$1,750	Engineer's Estimate, based on recent procurement
Concrete and Debris Removal Equipment Rental	0.4	Week	$6,250	$2,500	Engineer's Estimate, based on recent procurement, assumes backhoe, dozer, and excavator for two days
Concrete and Debris Removal	2	Day	$1,426	$2,852	Engineer's Estimate, assumes 3-man crew (10-hour days)
Roll-off concrete/debris disposal (10 cubic yards)	1	LS	$295	$295	Engineer's Estimate, based on quote, includes cost for roll-off
SUBTOTAL				**$7,397**	
Erosion and Sediment Controls					
Installation of Erosion and Sediment Controls	350	LF	$3.40	$1,190	Engineer's Estimate
SUBTOTAL				**$1,190**	
Remove Contaminated Soil					
Excavate and stockpile/load material	262	CY	$6.50	$1,703	Engineer's Estimate, contractor quote
SUBTOTAL				**$1,703**	
Confirmation Sampling					
Laboratory Analysis (Metals - lead, antimony)	12	EACH	$16.64	$200	Engineer's Estimate, based on recent procurement
SUBTOTAL				**$200**	

Alternative 2: Excavation with Offsite Disposal

Site: UXO-014 Former Indoor Pistol Range
Location: MCIEAST-MCB CAMLEJ, North Carolina
Phase: EE/CA
Date: 15-Jun-12

Description: Excavation of impacted surface soil to 1 foot below ground surface, with offsite disposal as hazardous waste

Description	Qty	Unit	Unit Cost	Total Cost	Notes
Disposal Characterization					
TCLP, reactivity, ignitability and corrosivity analysis	1	EACH	$736.48	$736	1 per 500 tons
SUBTOTAL				**$736**	
Transportation and Disposal (Hazardous Waste)					
Transportation and Disposal of Hazardous Soil	393	Ton	$445	$174,885	Quote from A&D
Rolloff - Mobilization/Demobilization/Cleaning	27	Rolloff	$850	$22,950	Quote from A&D, assumes 15 tons per rolloff
Rolloff rental (10 cubic yards)	756	day	$16	$12,096	Quote from A&D, assumes each rolloff needed for one month (28 days)
SUBTOTAL				**$209,931**	
Site Restoration/Demobilization					
Backfill Placement	393	ton	$6.75	$2,653	Engineer's Estimate, contractor quote
Backfill Delivery	20	trip	$215	$4,225	Engineer's Estimate, contractor quote
Seeding (upland)	0.16	ACRE	$2,178	$348	Engineer's Estimate
Decon/Demob Equipment	1	LS	$5,000	$5,000	
Remove/Dispose Pad	1	LS	$1,000	$1,000	
SUBTOTAL				**$13,226**	
SUBTOTAL CAPITAL COSTS				**$239,383**	
PROFESSIONAL SERVICES					
Final Design, Plans, Submittals	1	LS	$17,000	$17,000	
Construction Management	10	Days	$2,250	$22,500	
Project Management	10	Days	$1,850	$18,500	
SUBTOTAL PROFESSIONAL SERVICES				**$58,000**	

Alternative 2: Excavation with Offsite Disposal

Site: UXO-014 Former Indoor Pistol Range
Location: MCIEAST-MCB CAMLEJ, North Carolina
Phase: EE/CA
Date: 15-Jun-12

Description: Excavation of impacted surface soil to 1 foot below ground surface, with offsite disposal as hazardous waste

SUBTOTAL		**$297,383**
Contingency	15%	$44,607
G&A & Fee	15%	$44,607
SUBTOTAL FEES		**$89,215**
TOTAL ALTERNATIVE 2 COST		**$386,598**

The costs presented above are provided as a Class 4 Rough Order of Magnitude (ROM) estimate and are not an offer to perform the work. Class 4 ROM Estimares are provided to an accuracy of +50 percent and -30 percent.

ROM Upper Range	**50%**	**$**	**579,897**
ROM Lower Range	**-30%**	**$**	**270,619**

Assumptions:

1) MEC Support
    * MEC support is not required
2) Erosion and Sediment Controls
    * Perimeter controls around the 350 foot perimeter are assumed.
3) Excavation
    * Depth of impacted surface soil is 1 foot
    * Excavated materials disposed at approved, permitted offsite landfill
    * It is assumed that the density of site soil is 1.5 tons/cy
    * 100% of waste is assumed to be hazardous, except concrete debris assumed to be non-hazardous
4) Confirmation Sampling
    * Collected and composited by grids in removal area (side wall and base)
    * Samples analyzed for lead and antimony
5) Disposal Characterization
    * 1 sample per 500 tons of soil
    * Actual frequency of disposal characterization samples will be based on disposal facility
6) Site Restoration
    * Seed will be applied to the excavated area at a rate of 40 pounds per acre for erosion control.
    * Excavation will be backfilled using clean soil that has been stockpiled on site.
7) The project is expected to require approximately 1 week total in the field.

Notes:

cu yd = cubic yard
cu ft = cubic feet
ft = foot, feet
LF = linear foot
mobe/demobe = mobilization/demobilization
sq ft = square feet
MEC = munitions and explosives of concern

Alternative 3: In Situ Stabilization with Excavation and Offsite Disposal

Site: UXO-014 Former Indoor Pistol Range
Location: MCIEAST-MCB CAMLEJ, North Carolina
Phase: EE/CA
Date: 15-Jun-12

Description: In situ stabilization of impacted soils, followed by excavation to 1 foot below ground surface for offsite disposal as non-hazardous

Description	Qty	Unit	Unit Cost	Total Cost	Notes
CAPITAL COSTS					
Construction Management Mob					
Mobilization and Setup	1	LS	$5,000	$5,000	Engineer's Estimate, based on recent procurement
SUBTOTAL				**$5,000**	
Site Preparation					
Survey of excavation boundary	1	Day	$1,750	$1,750	Engineer's Estimate, based on recent procurement
Concrete and Debris Removal Equipment Rental	0.4	Week	$6,250	$2,500	Engineer's Estimate, based on recent procurement, assumes backhoe, dozer, and excavator for two days
Concrete and Debris Removal	2	Day	$1,426	$2,852	Engineer's Estimate, based on recent procurement, assumes 3-man crew (10-hour days)
Roll-off concrete/debris disposal (10 cubic yards)	1	LS	$295	$295	Engineer's Estimate, based on quote, includes cost for roll-off
SUBTOTAL				**$7,397**	
Erosion and Sediment Controls					
Installation of Erosion and Sedient Controls	350	LF	$3.40	$1,190	Engineer's Estimate
SUBTOTAL				**$1,190**	
Soil Stabilization					
EnviroMag Course Blend (for lead only)	15.72	Ton	$425	$6,681	Assume 4% based on quote from EB
Delivery	1	truckld	$1,500	$1,500	Contractor quote from EnviroBlend
Application and Mixing of Amendment into Soil	0.16	ACRE	$5,200	$832	Engineer's Estimate, contractor quote
SUBTOTAL				**$9,013**	

Alternative 3: In Situ Stabilization with Excavation and Offsite Disposal

Site: UXO-014 Former Indoor Pistol Range
Location: MCIEAST-MCB CAMLEJ, North Carolina
Phase: EE/CA
Date: 15-Jun-12

Description: In situ stabilization of impacted soils, followed by excavation to 1 foot below ground surface for offsite disposal as non-hazardous

Description	Qty	Unit	Unit Cost	Total Cost	Notes
Remove Contaminated Soil					
Excavate and stockpile/load material	272	CY	$6.50	$1,771	Engineer's Estimate, contractor quote
SUBTOTAL				**$1,771**	
Confirmation Sampling					
Laboratory Analysis (Metals - lead and antimony)	12	EACH	$16.64	$200	Engineer's Estimate, based on recent procurement
SUBTOTAL				**$200**	
Disposal Characterization					
TCLP, reactivity, ignitability and corrosivity analysis	2	EACH	$736.48	$1,473	1 per 500 tons for pre- and post-treatment analysis
SUBTOTAL				**$1,473**	
Transportation and Disposal (Nonhazardous Waste)					
Transportation and Disposal of Non-Hazardous Soil	409	Ton	$131	$53,542	Quote from A&D
Rolloff - Mobilization/Demobilization/Cleaning	28	Rolloff	$850	$23,800	Quote from A&D, assumes 15 tons per rolloff
Rolloff rental (10 cubic yards)	784	day	$16	$12,544	Quote from A&D, assumes each rolloff needed for one month (28 days)
SUBTOTAL				**$89,886**	
Site Restoration/Demobilization					
Backfill Placement	409	ton	$6.75	$2,759	Engineer's Estimate, contractor quote
Backfill Delivery	21	trip	$215	$4,515	Engineer's Estimate, contractor quote
Seeding (upland)	0.16	ACRE	$2,178	$348	Engineer's Estimate
Decon/Demob Rapidmix	1	LS	$25,000	$25,000	
Remove/Dispose Pad	1	LS	$5,000	$5,000	
SUBTOTAL				**$37,622**	

Alternative 3: In Situ Stabilization with Excavation and Offsite Disposal

Site: UXO-014 Former Indoor Pistol Range
Location: MCIEAST-MCB CAMLEJ, North Carolina
Phase: EE/CA
Date: 15-Jun-12

Description: In situ stabilization of impacted soils, followed by excavation to 1 foot below ground surface for offsite disposal as non-hazardous

SUBTOTAL CAPITAL COSTS **$153,552**

Description	Qty	Unit	Unit Cost	Total Cost	Notes
PROFESSIONAL SERVICES					
Final Design, Plans, Submittals	1	LS	$13,000	$13,000	
Construction Management	15	Days	$2,250	$33,750	
Project Management	15	Days	$1,850	$27,750	
SUBTOTAL PROFESSIONAL SERVICES				**$74,500**	
SUBTOTAL				**$228,052**	
Contingency	15%			$34,208	
G&A & Fee	15%			$34,208	
SUBTOTAL FEES				**$68,416**	
TOTAL ALTERNATIVE 4 COST				**$296,468**	

The costs presented above are provided as a Class 4 Rough Order of Magnitude (ROM) estimate and are not an offer to perform the work. Class 4 ROM Estimares are provided to an accuracy of +50 percent and -30 percent.

ROM Upper Range	**50%**	**$ 444,702**
ROM Lower Range	**-30%**	**$ 207,528**

Alternative 3: In Situ Stabilization with Excavation and Offsite Disposal

Site: UXO-014 Former Indoor Pistol Range
Location: MCIEAST-MCB CAMLEJ, North Carolina
Phase: EE/CA
Date: 15-Jun-12

Description: In situ stabilization of impacted soils, followed by excavation to 1 foot below ground surface for offsite disposal as non-hazardous

Assumptions:

1) MEC Support
    * MEC support is not required
2) Erosion and Sediment Controls
    * Perimeter controls around the 350 foot perimeter are assumed.
3) Excavation
    * Depth of impacted surface soil is 1 ft
    * Following treatment, all waste will be characterized as non-hazardous soil for offsite disposal at a Subtitle D landfill
    * It is assumed that the density of site soil is 1.5 tons/cy
4) Stabilization
    * All excavated material will require mechanical screening prior to disposal
    * Excavation rate will be limited by screening; screening will be at a rate of 400 cu yd per day
    * Stabilization amendment is assumed to be EnviroBlend EnviroMag for the whole site and EnvrioBlend AS for antimony, which will be mixed into the soil in situ.
    * 4% of EnviroBlend and EnviroMag by weight will be added.
5) Confirmation Sampling
    * Collected and composited by grids in removal area (side wall and base)
    * Samples analyzed for lead and antimony
6) Disposal Characterization
    * 1 sample per 500 tons of soil
    * Actual frequency of disposal characterization samples will be based on disposal facility
7) Site Restoration
    * Seed will be applied to the excavated area at a rate of 40 pounds per acre for erosion control.
    * Excavation will be backfilled using clean soil that has been stockpiled on site.
8) The project is expected to require up to 2 weeks in the field.

Notes:

cu yd = cubic yard
cu ft = cubic feet
ft = foot, feet
LF = linear foot
mobe/demobe = mobilization/demobilization
sq ft = square feet
MEC = munitions and explosives of concern

Appendix F
Sustainability Analysis Technical Memorandum

APPENDIX F

Sustainability Analysis for UXO-14 Former Indoor Pistol Range RR-53

Introduction

This appendix presents the approach taken and results obtained from a sustainability analysis that was completed for UXO-14 Former Indoor Pistol Range RR-53 at Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) in Onslow County, North Carolina.

Alternatives are presented to address UXO-14 COCs in surface soil in the vicinity of the Former Indoor Pistol Range. A detailed summary of the removal action alternatives is provided in Section 4 of the UXO-14 Engineering Evaluation/Cost Analysis (EE/CA) A sustainability analysis was performed by CH2M HILL using SiteWise™ Version 2.0 (Battelle, 2011) for the following remedial alternatives:

- Alternative 1 - No Action
- Alternative 2 – Excavation and Offsite Disposal
- Alternative 3 – *In Situ* Soil Stabilization with Excavation and Offsite Disposal

Method and Assumptions

The SiteWise^{TM} tool (Battelle, 2011) consists of a series of Excel-based spreadsheets used to conduct a baseline assessment of sustainability metrics. The assessment is carried out using a spreadsheet-based building block approach, where every remedial alternative is first broken down into modules that mirror the phases of remedial action work, specifically: remedial investigation (RI), remedial action construction (RAC), remedial action operation (RAO), and long-term monitoring (LTM).

SiteWise^{TM} uses various emission factors from governmental or non-governmental research sources to determine the environmental impact of each activity. The quantitative metrics calculated by the tool include:

1) Greenhouse gases (GHGs) reported as carbon dioxide equivalents (CO_2e), consisting of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O);
2) Energy usage (expressed as British Thermal Units [BTU]);
3) Water usage (gallons of water);
4) Air emissions of criteria pollutants consisting of nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM_{10}); and
5) Accident risk (risk of injury and risk of fatality).

For the purpose of this discussion the term footprint will be used to describe the quantified emissions or quantities for each metric. To estimate the sustainability footprint for each remedial alternative, only those elements of the RI, RAC, RAO, and LTM possessing important sustainability elements were included in the assessment. The No Action alternative is not analyzed because there are no impacts to environmental and social metrics. The footprints of each remedial phase are combined into overall footprints for each remedial action.

A lower environmental footprint indicates lower deleterious impacts to environmental and social metrics, which collectively make up the SiteWise^{TM} sustainability metrics. Conversely, a higher environmental footprint indicates higher deleterious impacts associated with the SiteWise^{TM} metrics. The major conclusions of this sustainability analysis are incorporated into the short-term effectiveness criteria evaluation of the EE/CA report.

Detailed assumptions for surface soil alternatives are provided in **Tables F-1** and **F-2**. The following is a description of the major activities for each alternative covered under the respective remedial action phase.

- RI: No actions for any alternative.

- RAC: Transportation of personnel, materials, equipment, material use, equipment use, onsite labor hours, and residual handling.
    - Alternative 2 involves the excavation and backfill of 260 cubic yards (cy) of soil. This includes the transportation of personnel and equipment for the excavation, equipment use, and offsite disposal of hazardous waste.
    - Alternative 3 involves *in situ* soil stabilization with excavation and offsite disposal. This includes the production of the stabilization agent EnviroBlend® and the backfill soil. It includes the transportation of personnel, equipment, and materials required to till the EnviroBlend® into the soil up to 1 foot. The offsite disposal of non-hazardous waste is also included.
- RAO: No actions for any alternative
- LTM: No actions for any alternative

General Assumptions

The specific assumptions made for the individual remedies are presented in **Tables F-1** and **F-2**. The following overall assumptions are used for the SiteWise™ tool evaluation:

- Distance to IDW landfill:
    - Assume all non-hazardous waste will be transported to a landfill located 200 miles away from MCIEAST-MCB CAMLEJ.
    - Assume all hazardous waste will be transported to a landfill located 700 miles away from MCIEAST-MCB CAMLEJ.
- The distances per trip for materials shipped onsite and IDW shipped offsite were included at full weight going one way and empty weight going one way.
- The complete environmental footprint for production of equipment used, or production of the vehicles used for transportation, is not considered in this analysis.
- The transportation of Enviroblend® was captured using the EQUIPMENT TRANSPORTATION section. Transportation of soil for backfill was captured in the RESIDUAL HANDLING section.
- The following average distances traveled were used unless specific distances were known:
    - Local Oversight– 30 miles roundtrip
    - Oversight from Raleigh– 250 miles roundtrip
    - Utility Location – 250 miles roundtrip
    - Surveying – 250 miles roundtrip
    - Local Operators/Labors –50 miles roundtrip
    - EnviroBlend® – 500 miles one way
    - Heavy Equipment – 50 miles roundtrip
    - Soil for backfill/cap – 10 miles one way
- Soil weighs approximately 1.5 tons/cy
- Water use was considered negligible and not included in this analysis

Results and Conclusions

The overall quantitative footprints for each alternative are provided along with the relative impact of each alternative in each footprint (**Table F-3**). The relative impact is a qualitative assessment of the relative footprint of each alternative, a rating of high, medium, or low is assigned to each alternative based on its performance against the other alternatives. The tool assigns a ranking of high to the highest footprint in each category and assigns the rankings of other alternatives based on the difference in the data between alternatives. The ranking is based on a 30 percent difference, if the footprints of two alternatives are within 30 percent of each other they will be given the same rating and there is, in effect, no difference between the alternatives. This allows for uncertainty inherent in the assumptions used in the model.

It should be noted that while this analysis compares the environmental footprints of each of the alternatives, the alternatives provide different end-uses. Therefore, a comparison of the results of the alternatives needs to be made in the context of the benefits (e.g., ARAR compliance, contaminant reduction, cost effectiveness, and etc.) of each of the alternatives.

A comparative analysis for Removal Action Alternatives 2 and 3 is summarized in **Figure F-1**. **Table F-3** presents a comparison of the quantitative environmental footprint metrics evaluated for each of the remedial alternatives.

Alternative 1 has no sustainability impacts because no action occurs, however, this alternative does not meet removal goals. Overall, of the two remaining active removal actions, Alternative 2 has the largest impact in all categories. The footprints for each alternative are discussed below.

- Alternative 1— No Action

This alternative has no sustainability impacts because no action occurs.

- Alternative 2 – Excavation and Offsite Disposal

The transportation of the hazardous waste accounted for the majority of the GHG, total energy, SO_X, NO_X, and PM_{10} footprints. The fossil fuel consumption during the extraction of the fill soil and the onsite equipment use composed the remainder of the footprint. In addition to personnel and backfill soil and hazardous IDW transportation, onsite labor hours contributed to the accident risk fatality and injury footprints. Results are provided in **Table F-5** and **Figure F-2**.

- Alternative 3 – *In Situ* Stabilization with Excavation and Offsite Disposal

The transportation of the non-hazardous IDW, the production of EnviroBlend® and the extraction of fill soil were the primary contributors to GHG and total energy footprints. The residual handling also accounted for the majority of the SO_X, and NO_X footprints. Residual handling, equipment use, and labor hours onsite contributed to the accident fataility and injury risk. Results are provided in **Table F-5** and **Figure F-3**.

Uncertainty Assessment

A generic metals stabilization agent (lime) was used in substitution for the chosen agent EnviroBlend®, which is a blend magnesium oxide/hydroxide and calcium phosphate. Lime is used as a proxy for Enviroblend® and does not have identical life-cycle impacts. However, given the scope of this assessment, the use of lime in lieu EnviroBlend® is considered a reasonable proxy. SiteWise™ does not account for the water use, NO_X, SO_X, and PM_{10} and the overall impact of lime and these constituents may be underestimated

The SiteWise™ tool calculates environmental and risk footprints based on industry averages, published emissions factors, and generalized data sources. The footprint results are not representative of actual emissions and should be used for comparative purposes only.

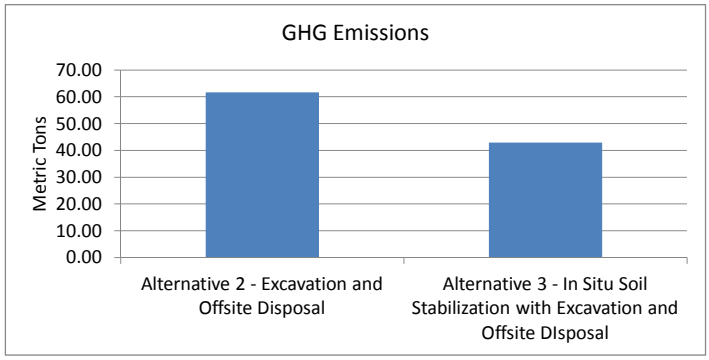
Recommendations

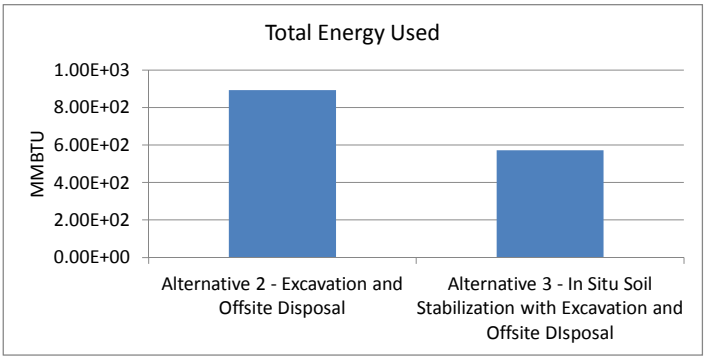
The estimates from the SiteWise tool were used to estimate the environmental footprint of the alternatives. Once the alternative is selected, it is recommended the footprint of the selected alternative be further evaluated in the design phase of the projects to explore opportunities to optimize the environmental footprint of the project and integrate sustainable remediation best practices in the design, construction, and operation of the alternative.

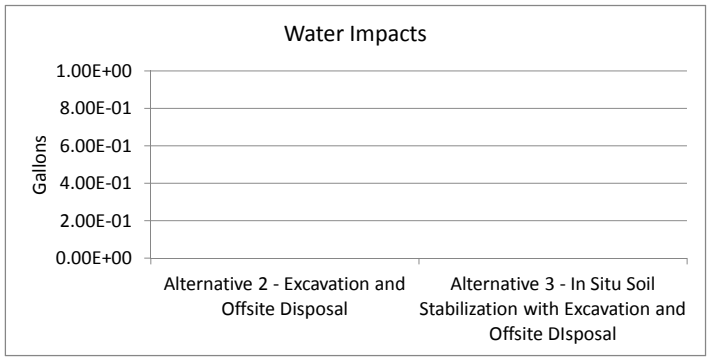
References

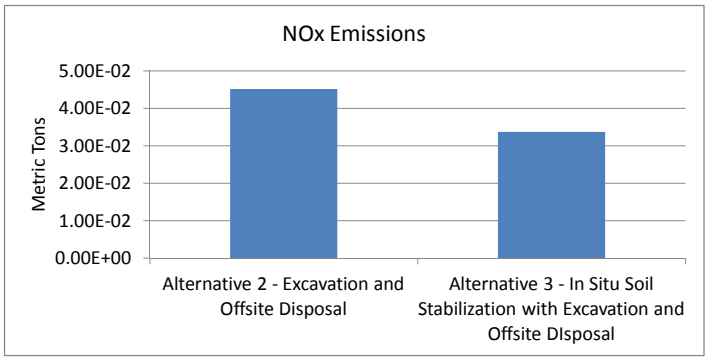
Battelle. 2011. *SiteWise™ Version 2 User Guide*. NAVFAC Engineering Service Center, UG-2092-ENV. June.

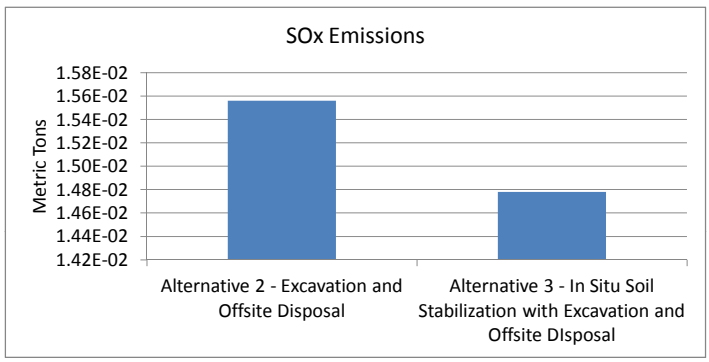
Figures

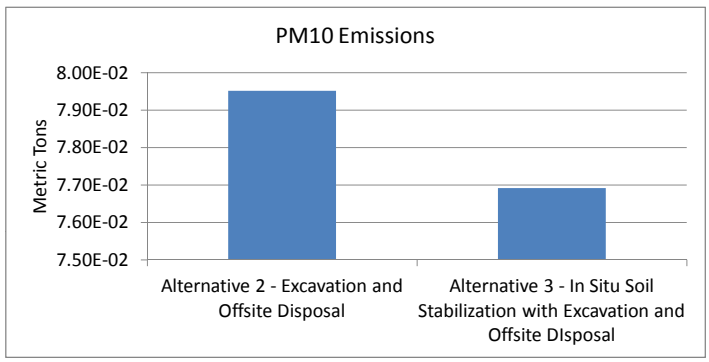


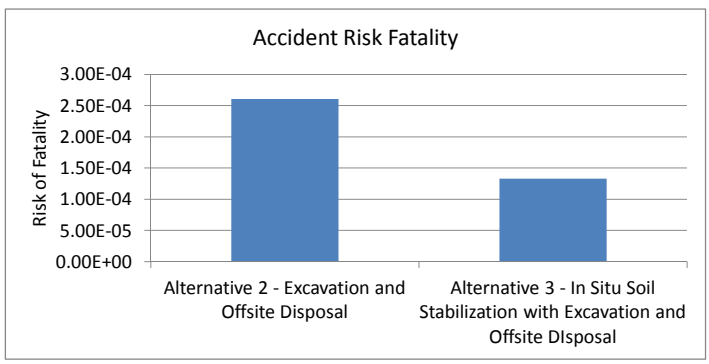












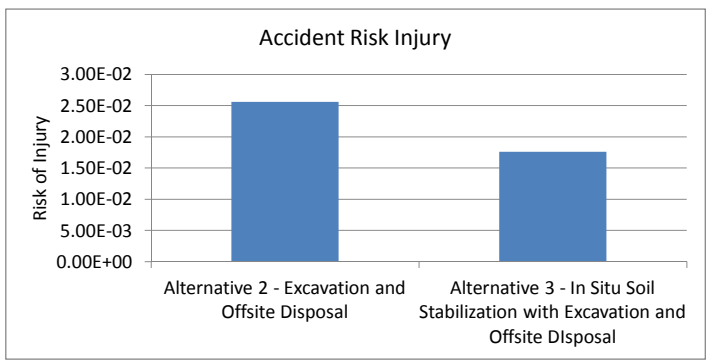
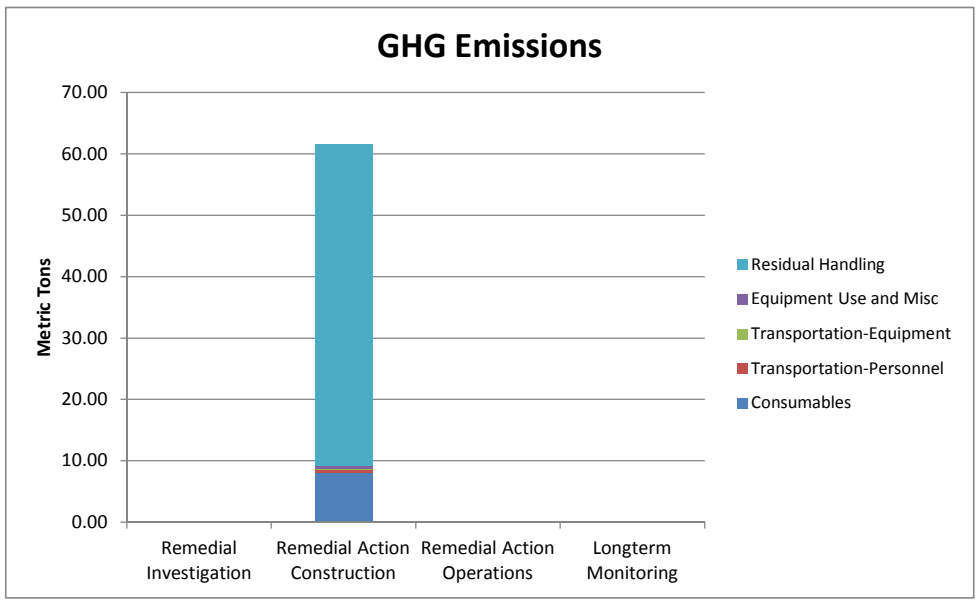
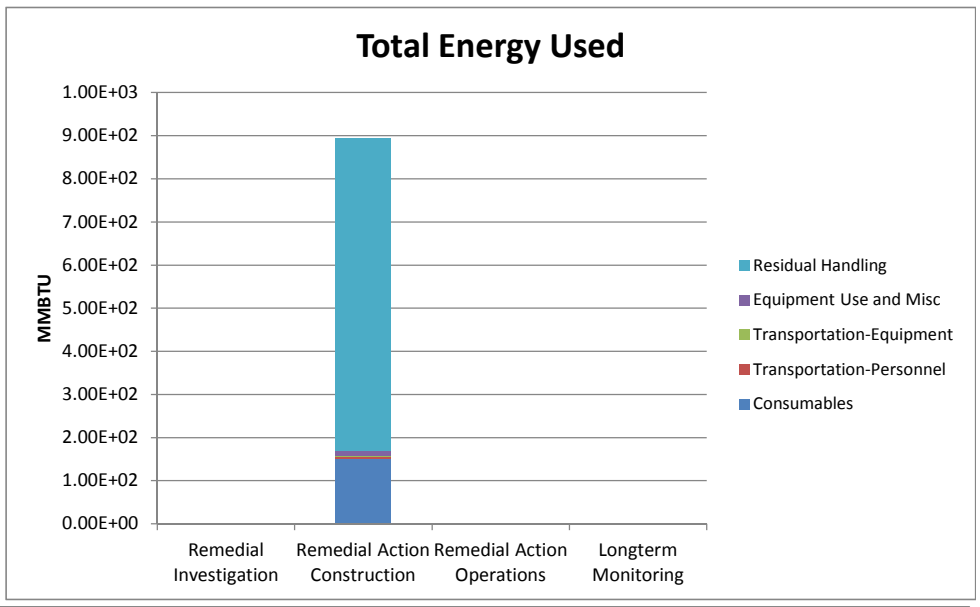
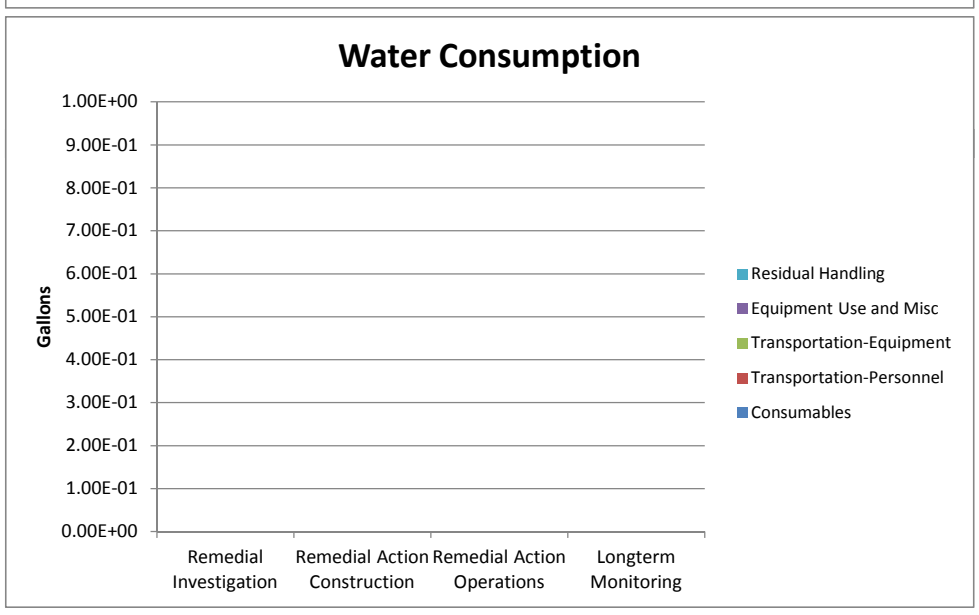
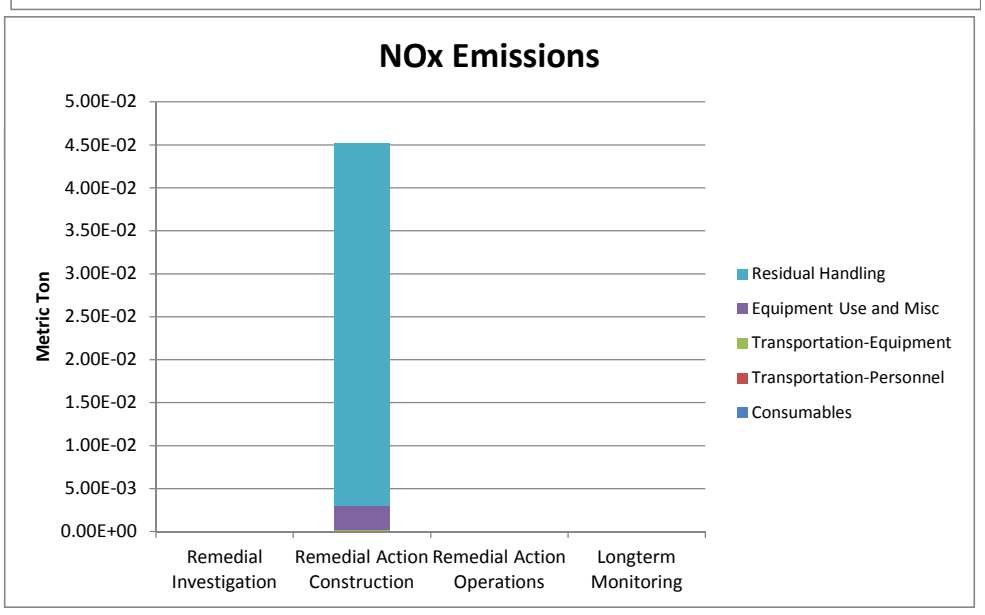


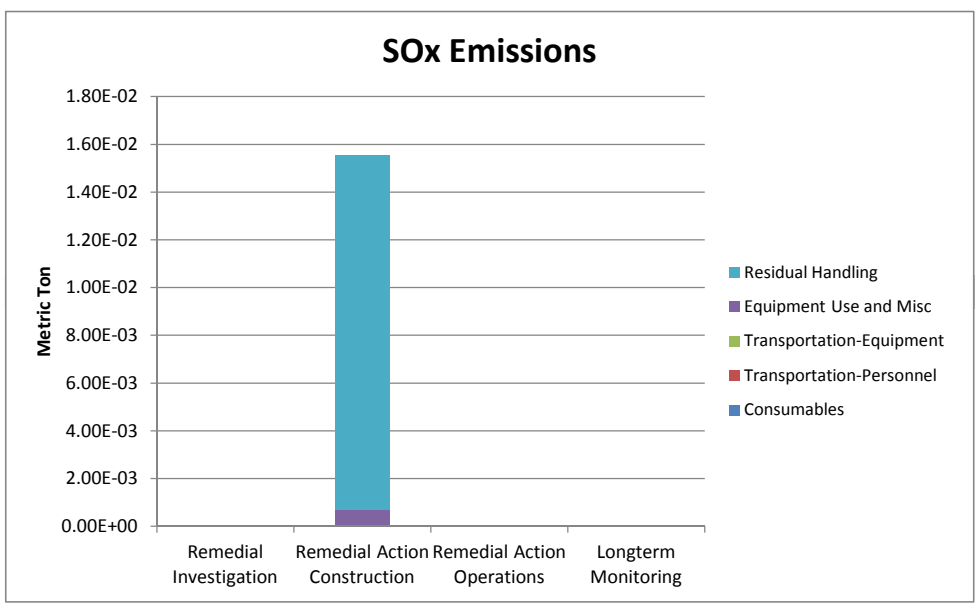
Figure F-1
SiteWise™ Analysis Summary
UXO-14 EE/CA
MCIEAST - MCB CAMLEJ, North Carolina

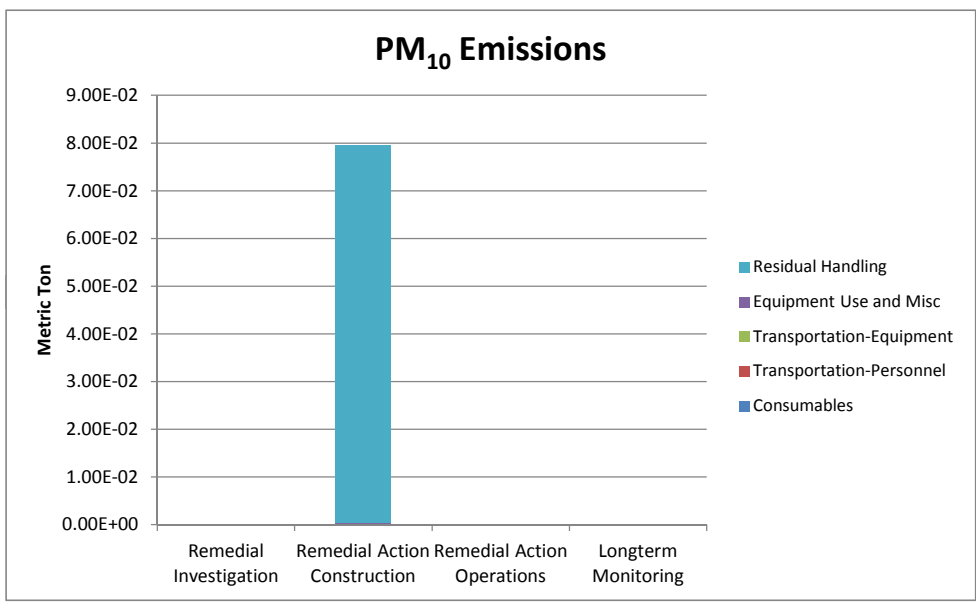


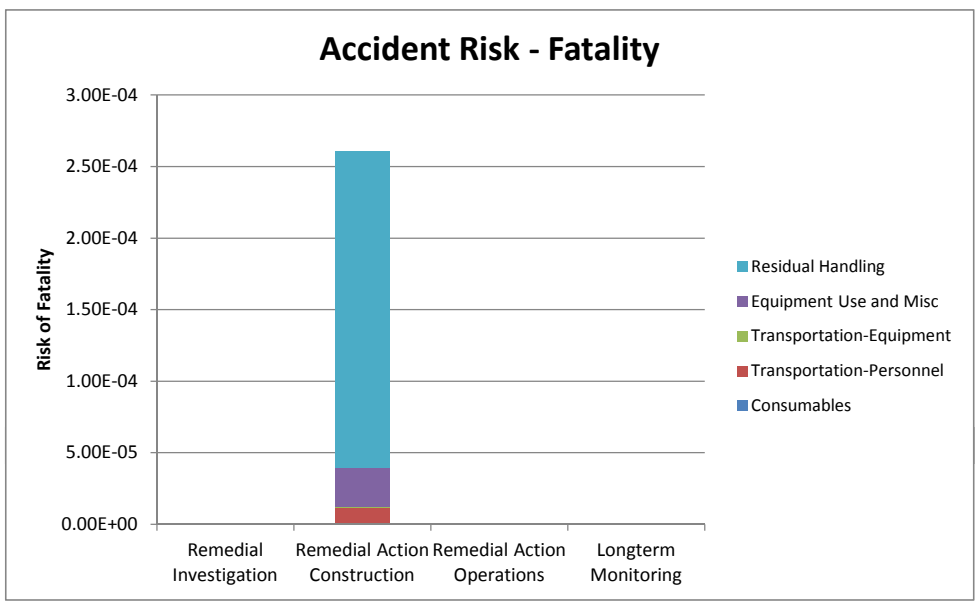












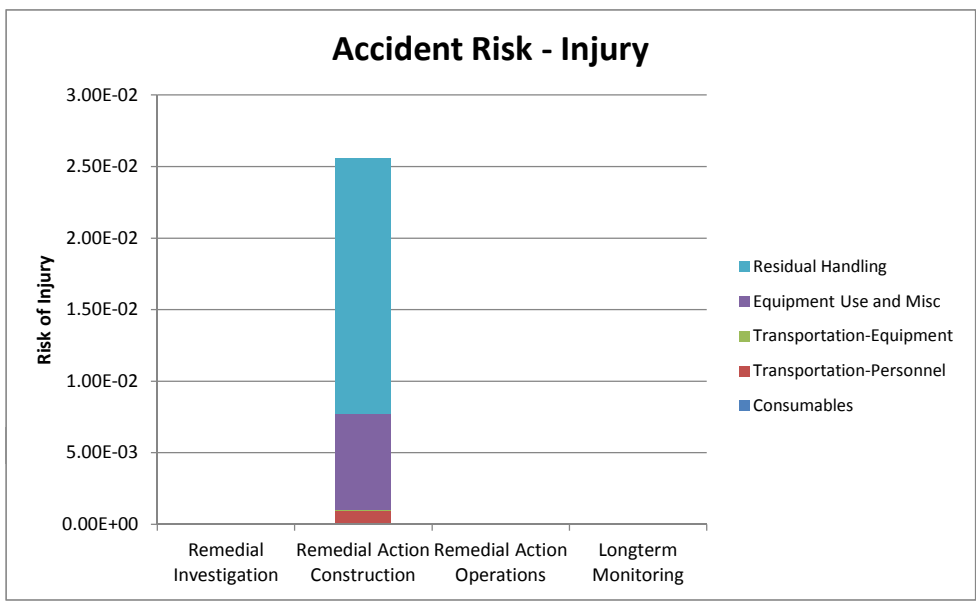
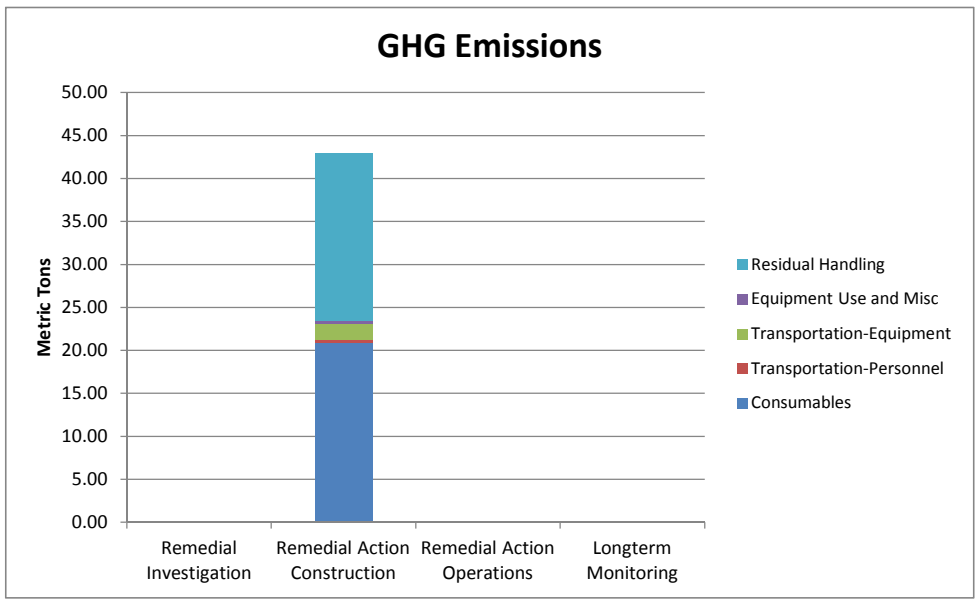
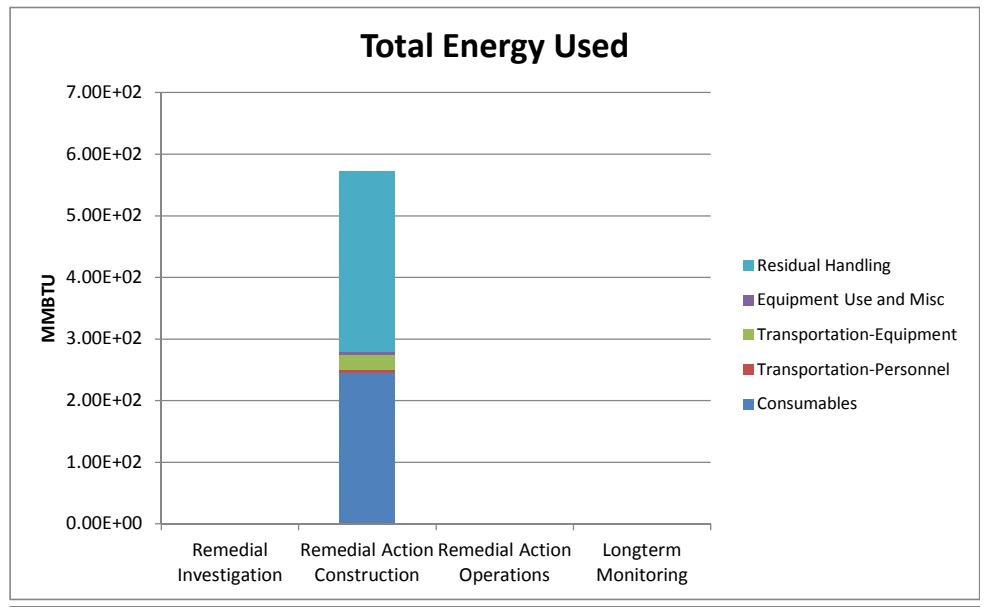
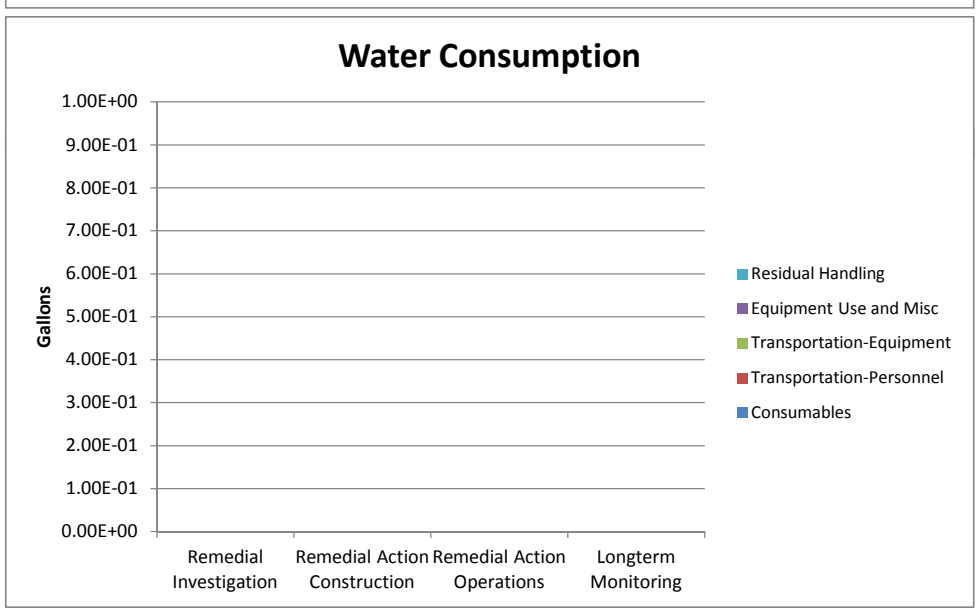
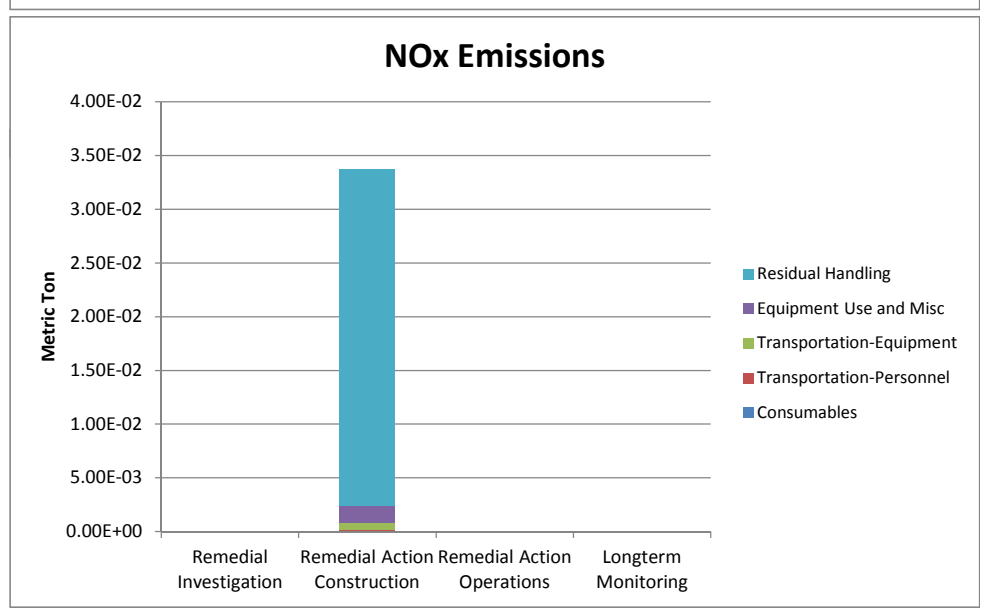


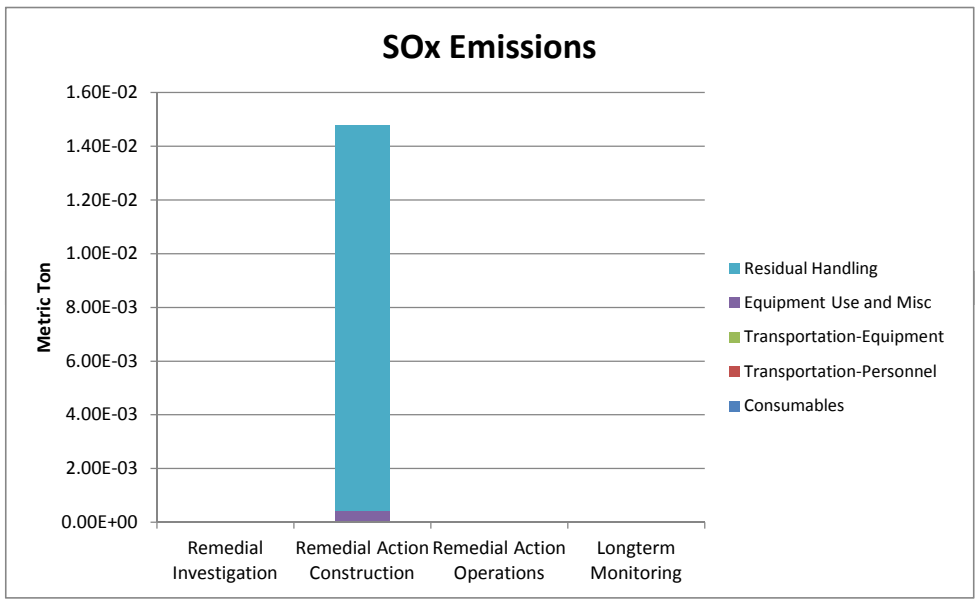
Figure F-2
Alternative 2 - Excavation and Offsite Disposal Summary
UXO-14 EE/CA
MCIEAST - MCB CAMLEJ, North Carolina

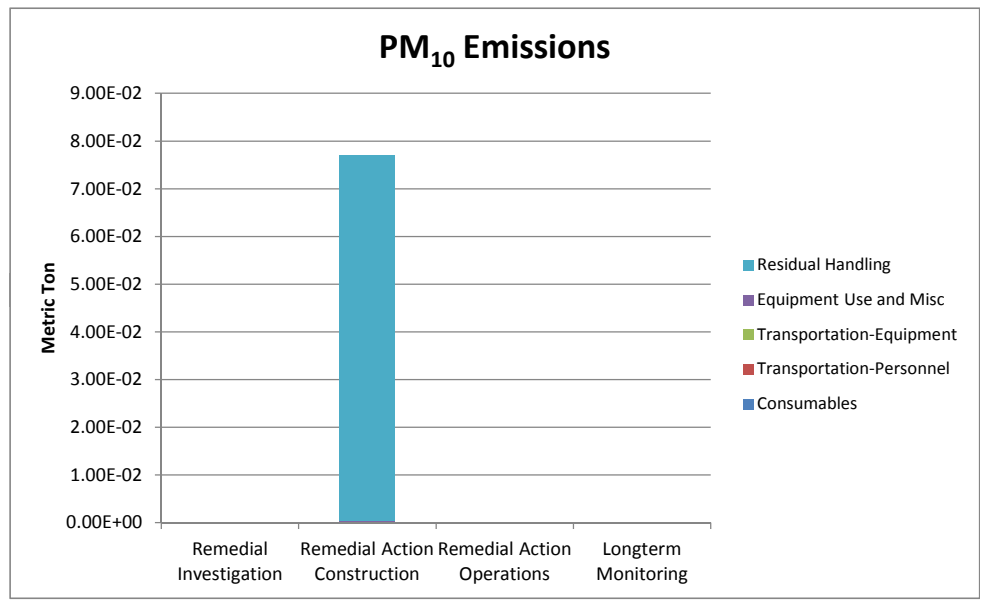


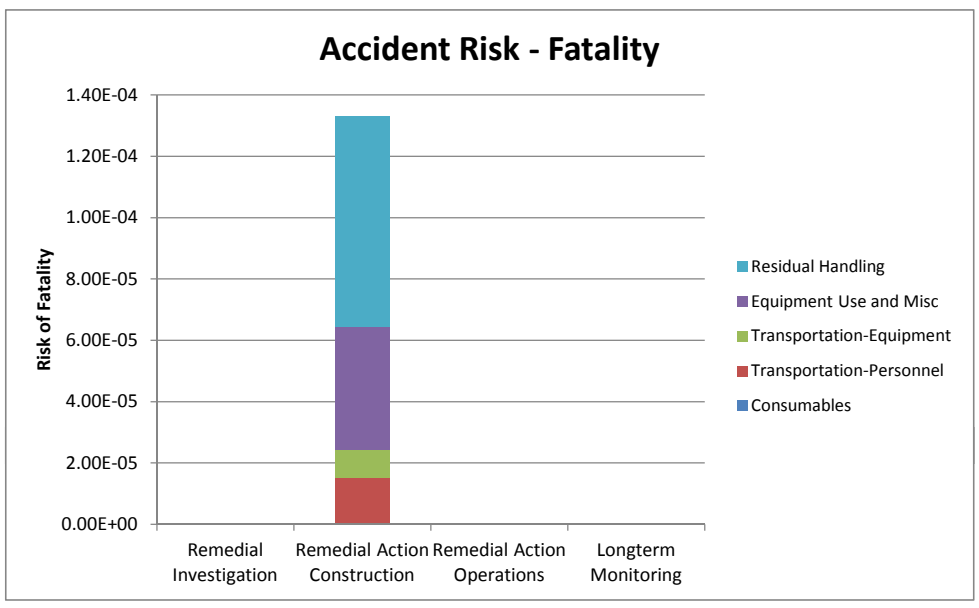












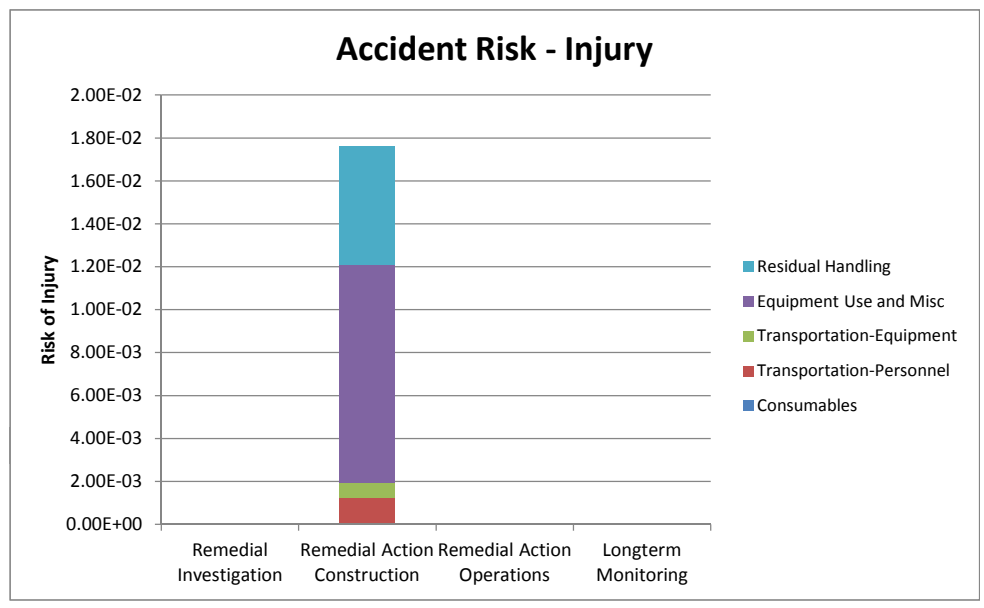


Figure F-3
Alternative 3 - In Situ Soil Stabilization with Excavation and Offsite Disposal Summary
UXO-14 EE/CA
MCIEAST - MCB CAMLEJ, North Carolina

Tables

TABLE F-1

Soil Alternative 2 - Excavation and Offsite Disposal

UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	Excavate and backfill 260 cy of soil
Material Production	Soil fill (includes general and structural fill) 260 cy *1.5 tons/cy * 2000 lb / ton = 780,000 lbs
Personnel Transportation - Road	Oversight - 1 driver, 30 miles R/T local (5 trips) Utility locating - 1 driver, 250 miles R/T from Raleigh (1 trip) Surveying - 2 people, 250 miles R/T from Raleigh (1 trip) Laborers/Operators - 4 people, 2 vehicles, 30 miles R/T (10 trips total)
Equipment Transportation - Road	1 front-end loader, 1 excavator, assume 20 tons each, 50 miles R/T (2 trips = 100 miles total)
Equipment use - Earthwork	Assume that Loader and Excavator moves the total amount of soil twice (once during excavation and once during backfilling) = 520 cy of soil each piece
Residual Handling/Fill Material Transport	Fill materials - from Base borrow pit shipped 10 miles 1 way Assume 20 tons/truck = 20 full truck loads from Base Borrow pit and 20 empty truck loads Excavated soil - assume same volume as fill material, hazardous soil - disposed of at landfill 700 miles away (assume 20 tons/truck = 20 trips one way), 20 trips empty 390 tons to a hazardous waste landfill
Labor Hours Onsite	**280 Hours. (**10 hours/person for utility location and surveying. 10 hours/day for 5 days for 2 equipment operators, 2 laborers, and 1 oversight)
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

R/T = round trip

ft = feet

sf = square feet

cy = cubic yards

TABLE F-2

Soil Alternative 3 - In Situ Soil Stabilization with Excavation and Offsite Disposal

UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

SITEWISE TAB	Assumptions
Remedial Investigation	No Actions
Remedial Action Construction	In Situ Stabilization and Offsite Disposal
Material Production	Soil fill - 272 cy * 1.5 tons/cy * 2000 lb/ton = 816,000 lbs EnviroBlend® (Use Lime as Proxy) - 16 tons (32,000 lbs)
Personnel Transportation - Road	Oversight - 1 driver, 30 miles R/T local (8 trips) Utility locating - 1 driver, 250 miles R/T from Raleigh (1 trip) Surveying - 2 people, 250 miles R/T from Raleigh (1 trip) Operators/Laborers - 4 people, 2 trucks, 30 miles R/T (16 trips total)
Equipment Transportation - Road	1 tiller, 1 excavator, 1 front-end loader,assume 20 tons each, 50 miles R/T (3 trips = 150 miles total) EnviroBlend® - 16 tons per trip, 1 trip, 500 miles full, 500 miles empty
Equipment use - Earthwork	Assume the tiller spreads and tills in one pass (to 12 inches) Assumptions: 0.16 acre of untilled sandy soil. 3 working days. Assume that Loader and Excavator moves the total amount of soil twice (once during excavation and once during backfilling) = 520 cy of soil each piece
Residual Handling/Fill Material Transport	Fill materials - from Base borrow pit shipped 10 miles one way Assume 20 tons/truck = 20 full truck loads from Base Borrow pit/ 20 empty truck loads Excavated soil - assume same volume as fill material, non-hazardous soil - disposed of at landfill 200 miles away (assume 20 tons/truck = 21 trips one way), 21 trips empty 420 tons to a non-hazardous waste landfill
Labor Hours Onsite	**430 Hours.** (10 hours/person for utility location and surveying. 10 hours/day for 8 days for 2 equipment operators, 2 laborers, and 1 oversite)
Remedial Action Operations	No Actions
Longterm Monitoring	No Actions

Notes:

R/T = round trip

ft = feet

sf = square feet

cy = cubic yards

TABLE F-3

Relative Impact of Alternatives

UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 1- No Action	0	0	0	0	0	0	0	0
Alternative 2 - Excavation and Offsite Disposal	61.6	893	0	4.52E-02	1.56E-02	7.95E-02	2.61E-04	2.56E-02
Alternative 3 - In Situ Soil Stabilization with Excavation and Offsite Disposal	42.9	573	0	3.37E-02	1.48E-02	7.69E-02	1.33E-04	1.76E-02

Remedial Alternatives	GHG Emissions	Total energy Used	Water Used	NO_x emissions	SO_x Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
	metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Alternative 1- No Action	Low	Low	Low	Low	Low	Low	Low	Low
Alternative 2 - Excavation and Offsite Disposal	High	High	Low	High	High	High	High	High
Alternative 3 - In Situ Soil Stabilization with Excavation and Offsite Disposal	Medium	Medium	Low	High	High	High	Medium	Medium

The relative impact is a qualitative assessment of the relative footprint of each alternative, a rating of High for an alternative is assigned if it is at least 70 percent of the maximum footprint, a rating of Medium is assigned if it is between 30 and 70 percent of the maximum footprint, and a rating of Low is assigned if it is less than 30 percent of the maximum footprint.

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

GHG - Greenhouse Gases

TABLE F-4

Alternative 2 - Excavation and Offsite Disposal

UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	8.14	150.90	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.36	4.55	NA	1.3E-04	4.7E-06	2.7E-05	1.2E-05	9.4E-04
	Transportation-Equipment	0.19	2.54	NA	6.1E-05	1.1E-06	5.4E-06	7.8E-07	6.3E-05
	Equipment Use and Misc	0.50	10.51	0.0E+00	2.8E-03	7.0E-04	3.2E-04	2.7E-05	6.8E-03
	Residual Handling	52.45	724.03	NA	4.2E-02	1.5E-02	7.9E-02	2.2E-04	1.8E-02
	Sub-Total	61.64	892.53	0.00E+00	4.52E-02	1.56E-02	7.95E-02	2.61E-04	2.56E-02
Total		**61.6**	**892.5**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

NA - Not Applicable

GHG - Greenhouse Gases

TABLE F-5

Alternative 3 - *In Situ* Soil Stabilization with Excavation and Offsite Disposal

UXO-14 EE/CA

MCIEAST-MCB CAMLEJ, North Carolina

Phase	Activities	GHG Emissions	Total Energy Used	Water Used	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Action Construction	Consumables	20.82	244	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.46	6	NA	1.7E-04	6.1E-06	3.5E-05	1.5E-05	2.2E-03
	Transportation-Equipment	1.90	25	NA	6.0E-04	1.1E-05	5.3E-05	9.0E-06	2.0E-03
	Equipment Use and Misc	0.26	5	0.0E+00	1.7E-03	3.9E-04	2.2E-04	4.0E-05	1.3E-02
	Residual Handling	19.51	293	NA	3.1E-02	1.4E-02	7.7E-02	6.9E-05	2.5E-04
	Sub-Total	42.95	573	0.00E+00	3.37E-02	1.48E-02	7.69E-02	1.33E-04	1.74E-02
Total		**42.9**	**572.7**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.0**

Notes:

MMBTU - million British Thermal Unit

NOx - Nitrogen Oxides

SOx - Sulfur Oxides

PM10 - Particulate Matter

NA - Not Applicable

GHG - Greenhouse Gases