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FINAL PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT FORMER 1,000 INCH RANGE AMPHIBIOUS BASE AREA UNEXPLODED ORDNANCE 15 (UXO 15) MCB CAMP LEJEUNE NC

3/1/2010

CH2M HILL

Final

Preliminary Assessment/Site Inspection Report, Former 1,000-inch Range (Amphibious Base Area)—UXO-15

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Task Order 30

March 2010

Prepared for

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

Under the

AGVIQ–CH2M HILL JV II Program
Contract N62467-03-D-0260

Prepared by

Charlotte, North Carolina

Executive Summary

This Preliminary Assessment/Site Inspection (PA/SI) presents data, results, and conclusions of the investigations conducted at the Former 1,000-inch Range (Amphibious Base Area) – UXO-15 (Archives Search Report [ASR] # 2.19), located at Marine Corps Base Camp Lejeune (MCB CamLej) in Jacksonville, North Carolina. The scope of the work was provided by Naval Facilities Engineering Command (NAVFAC) – Mid Atlantic Division, Joint Venture (JV) II Program Contract N62467-03-D-0260, Task Order (TO) 30. Field investigation activities were conducted in accordance with the *Work Plan Preliminary Assessment/Site Inspection– 1,000-Inch Range (Amphibious Base Area) – UXO-15, MCB Camp Lejeune, North Carolina* (CH2M HILL, 2008c). The Work Plan was approved by NAVFAC, MCB CamLej, the U.S. Environmental Protection Agency (USEPA), and the North Carolina Department of Environment and Natural Resources (NCDENR).

MCB CamLej is planning a military construction (MILCON) project within the Courthouse Bay area on 135 acres located immediately west of the Amphibious Vehicle Maintenance Area (OU 20, Site 73). The MILCON project area has been designated the Courthouse Bay Amphibious Area. The Former 1,000-inch Range is located within a 9-acre area of the northern portion of the Courthouse Bay Amphibious Area. This focused PA/SI was conducted to identify and characterize potential environmental impacts associated with the use of the Former 1,000-inch Range, to evaluate the potential risks to human health and the environment posed by historical land use practices, and to evaluate whether additional investigation or remediation activities are necessary.

Field activities included land surveying, vegetation clearing, buried utility locating, and environmental sampling. Environmental sampling activities included the collection and analysis of surface and subsurface soil. These samples were analyzed for select metals (antimony, arsenic, copper, lead, and zinc) by USEPA Method 6010B/6020 and perchlorates by USEPA Method 6850 in accordance with the Interstate Technology and Regulatory Council (ITRC) guidance for assessment of small arms ranges (ITRC, 2003).

The environmental investigation included collection of the following samples:

- Sixty-four composite surface soil samples (ASR2.19-SS01 through ASR2.19-SS64) were collected at a depth of 0 to 1 foot below ground surface (bgs).
- Fifty-three subsurface samples (ASR2.19-SB01 through ASR2.19-SB64) were collected at a depth of 5 to 6 feet bgs using a hand auger.
- Three composite soil samples (ASR2.19-SSSP1 through ASR2.19-SSSP3) were collected from the stockpile of soil removed from within the Former 1,000-inch Range during parking lot construction activities conducted in August and September 2008.

Surface Soil Analysis

Surface soil data was screened against USEPA Residential Soil Adjusted Regional Screening Level (RSLs) (USEPA, 2008), the North Carolina Department of Environment and Natural Resources Federal Remediation Branch Protection of Groundwater Preliminary Soil Remediation Goals (PSRGs) (NCDENR, 2010), and twice the mean Base background concentrations (2x Base background) for metals (Baker, 2001). Arsenic was the only metal detected at concentrations exceeding both the Residential RSL and 2x Base background screening criteria. No detected arsenic values were greater than the PSRG.

Subsurface Soil Analysis

Subsurface soil data was screened against USEPA Residential Soil Adjusted RSLs (USEPA, 2008), the PSRGs (NCDENR, 2010), and 2x Base background for metals (Baker, 2001). Arsenic (two samples) and antimony (one sample) were detected at concentrations exceeding the Residential RSL, 2x Base background, and PSRG screening criteria.

Human Health Risk Screening

The preliminary risk screening concluded that unacceptable human health risks may be present for metals in surface soil and total soil (surface and subsurface soil). Therefore, a baseline human health risk assessment (HHRA) was performed for the surface soils and total soils. The primary objective of the baseline HHRA was to assess the health risks associated with exposure to soil under current site land use conditions and potential future site use under conservatively protective land use assumptions. Results from the HHRA concluded surface soil and subsurface soil reasonable maximum exposure (RME) cancer risks for all receptors are within or below USEPA target risk levels.

Ecological Risk Screening

Potential receptors at the site may include plants, invertebrates, mammals, reptiles, and birds. Analytical results for surface soil were screened against ecological screening values (ESVs) intended to be protective of ecological receptors. Antimony and lead had maximum concentrations in excess of the available ecological soil screening levels (EcoSSLs). However, due to the low frequencies of exceedance (antimony was detected at a concentration above the ESV in two samples and lead exceeded the EcoSSL in three samples), low magnitudes of exceedance, and similarities to background concentrations for both antimony and lead, they are not likely to cause unacceptable risk to ecological receptors. Therefore, no risks to populations of ecological receptors are expected at the site.

Conclusions and Recommendations

Based on the review of both surface and subsurface soil analytical results, human health risk evaluations and ecological risk evaluations, no unacceptable risks exist for current or future human health exposure or ecological receptors.

Based on the evaluation of the historical site information, field sampling activities, laboratory analytical results, as well as the finding of no unacceptable human health and ecologic risks, no further action is recommended for the Former 1,000-inch Range.

Contents

Acronyms and Abbreviations

AAV Bn	Assault Amphibian Vehicle Battalion
amsl	above mean sea level
ASR	Archive Search Report
bgs	below ground surface
Cal EPA	California Environmental Protection Agency
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	chemical of potential concern
CSF	cancer slope factor
CSM	conceptual site model
CTE	central tendency estimate
°F	degrees Fahrenheit
EcoSSL	ecological soil screening level
ELCR	excess lifetime carcinogenic risk
EPC	exposure point concentration
ESV	ecological screening value
FFA	Federal Facilities Agreement
GI	gastrointestinal
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazards index
HQ	hazard quotient
IDW	investigation-derived waste
IRIS	Integrated Risk Information System
ITRC	Interstate Technology and Regulatory Council
JV	CH2M HILL-AGVIQ Joint Venture
MCB CamLej	Marine Corps Base Camp Lejeune
MCL	maximum contaminant level
MF	modifying factor
mg/kg	milligrams per kilogram
MILCON	Military Construction
MS/MSD	matrix spike/matrix spike duplicate
NAD83	North American Datum of 1983
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCDENR	North Carolina Department of Environment and Natural Resources
NCEA	National Center for Environmental Assessment

NPL	National Priorities List
OU	operable unit
PA/SI	Preliminary Assessment/Site Inspection
PPE	personnel protective equipment
PPRTV	Provisional Peer Reviewed Toxicity Value
PSRGs	North Carolina Department of Environment and Natural Resources Federal Remediation Branch Protection of Groundwater Preliminary Soil Remediation Goals
QA/QC	quality assurance/quality control
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RL	Reporting Limit
RME	reasonable maximum exposure
RSL	regional screening level
SOP	standard operating procedure
STSC	Superfund Health Risk Technical Support Center
TO	Task Order
UCL	upper confidence limit
UF	uncertainty factor
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
UXO	unexploded ordnance

SECTION 1

Introduction

This document presents the findings and conclusions of the Preliminary Assessment/Site Inspection (PA/SI) conducted at the Former 1,000-inch Range (Amphibious Base Area) – Unexploded Ordnance (UXO)-15 (Archive Search Report [ASR] # 2.19), located at Marine Corps Base Camp Lejeune (MCB CamLej) in Jacksonville, North Carolina. A regional location map of MCB CamLej and its surrounding area is provided as **Figure 1-1**.

A proposed military construction (MILCON) project, designated as the Courthouse Bay Amphibious Area, is located within the Courthouse Bay area on 135 acres located immediately west of the Amphibious Vehicle Maintenance Area (Operable Unit [OU] 20, Site 73). The Former 1,000-inch Range is located within a 9-acre area of the northern portion of the Courthouse Bay Amphibious Area. This focused PA/SI was conducted to identify and characterize potential environmental impacts associated with the use of the Former 1,000-inch Range, to evaluate the potential risks to human health and the environment posed by historical land use practices, and to evaluate whether additional investigation or remediation activities are necessary. This PA/SI was conducted in accordance with the *Work Plan Preliminary Assessment/Site Inspection – 1,000-Inch Range (Amphibious Base Area) – UXO-15, MCB Camp Leeune, North Carolina* (CH2M HILL, 2008c).

This PA/SI was conducted by CH2M HILL and AGVIQ under the Joint Venture (JV) II Program Contract N62467-03-D-0260, Task Order (TO) 30. This report is for submittal to Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, MCB CamLej, the United States Environmental Protection Agency (USEPA), and the North Carolina Department of Environment and Natural Resources (NCDENR).

1.1 Objectives and Approach

The primary objective of this field investigation was to evaluate the presence and nature of contamination that may exist within the 9-acre portion of the Courthouse Bay Amphibious Area previously occupied by the Former 1,000-inch Range. The objectives of the PA/SI included the following:

- Identify historical activities at the Courthouse Bay Amphibious Area that may have impacted environmental conditions at the site
- Evaluate the presence and nature of contamination that may exist at the Former 1,000-inch Range
- Conduct human health and ecological risk screenings

Potential site contaminants are heavy metals (primarily lead) that may leach from spent bullets and residues of materials used in bullet primer and igniter formulations. The field investigation accomplished the project objective through the following activities:

- Project planning and Work Plan development
- Subdividing the 9-acre investigation area into 64 sample grids measuring approximately 0.25 acres each
- Collecting composite surface soil samples consisting of five aliquots collected from each sample grid
- Collecting one subsurface soil sample from a depth of 5 to 6 feet below ground surface (bgs) from the center of each sample grid
- Analyzing the samples for select metals (antimony, arsenic, copper, lead and zinc) using USEPA Method 6010B and perchlorate using USEPA Method 6850.

1.2 Report Organization

The PA/SI report comprises the following sections:

- Section 1 – Introduction
- Section 2 – Site Background
- Section 3 – Field Investigation Activities and Data Evaluation
- Section 4 – Field Investigation Results
- Section 5 – Human Health Risk Assessment
- Section 6 – Ecological Risk Assessment
- Section 7 – Conclusions
- Section 8 – References

Figures and tables are provided at the end of each respective section and appendices are provided after Section 8.

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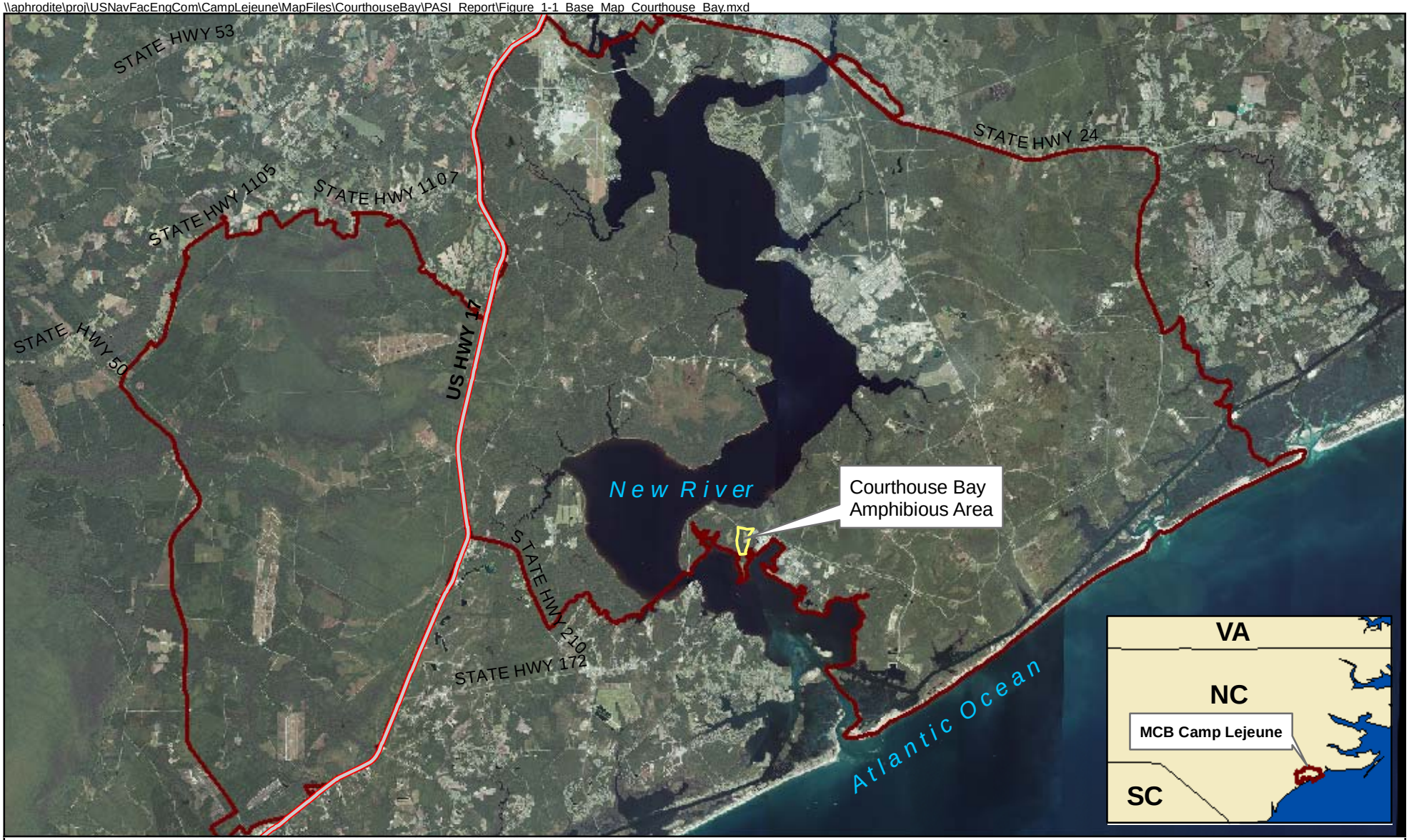

Legend

- Highways
- Installation Boundary
- Courthouse Bay Amphibious Areas

N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1-1
Base Location Map
PA/SI Report for the Former 1,000-Inch Range (Amphibious Base Area) - UXO-15
MCB CamLej
North Carolina

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SECTION 2

Site Background

2.1 MCB Camp Lejeune Setting and History

MCB CamLej encompasses approximately 236 square miles of land in Onslow County, North Carolina, adjacent to the southern boundary of the City of Jacksonville. Jacksonville is the largest city near MCB CamLej and contains approximately half of the county's total population. Since 1990, much of the MCB CamLej complex has been part of Jacksonville. The remaining areas adjacent to the Base are generally rural. The Base is bordered by the Atlantic Ocean to the south, U.S. Route 17 to the west, State Route 24 to the north, and the town of Hubert, North Carolina to the east and is bisected by the New River, which flows into the Atlantic Ocean in a southeasterly direction.

The MCB CamLej complex consists of six geographical locations under the jurisdiction of the Base command. These areas include Camp Geiger, Montford Point, Courthouse Bay, Mainside, the Greater Sandy Run Area, and the Rifle Range Area. **Figure 1-1** shows the location of the Courthouse Bay Amphibious Area.

MCB CamLej was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) effective November 4, 1989. Subsequent to this listing, the USEPA Region IV, NCDENR, the Department of the Navy (Navy), and the Marine Corps entered into a Federal Facilities Agreement (FFA) for MCB CamLej. The primary purpose of the FFA was to ensure that environmental impacts associated with past and present activities at the Base are thoroughly investigated and that appropriate CERCLA response and Resource Conservation and Recovery Act (RCRA) corrective action alternatives are developed and implemented, as necessary, to protect public health and welfare and the environment.

2.2 Site Description and History

The Courthouse Bay Amphibious Area covers an area of approximately 135 acres located immediately south of North Carolina Highway 172 (Sneads Ferry Road) as shown in **Figure 1-1.** The Former 1,000-inch Range (ASR # 2.19) comprises approximately 9 acres and is located in the northern portion of the Courthouse Bay Amphibious Area immediately south of North Carolina Highway 172, (Sneads Ferry Road) as shown in **Figures 1-2** and **2-1**. Access to the Courthouse Bay Amphibious Area is restricted to military personnel and authorized contractors; public access is restricted. The Former 1,000-inch Range investigation area is a mixture of cleared and wooded land.

According to the ASR, the 1,000-inch Range was established under Camp Training Order Number 7-1945 and disestablished and no longer used for firing live ammunition under Camp Training Order Number 5-1946, effective March 19, 1946. Small arms, including M1 rifles and .30- and .45-caliber pistols were typically fired at the 1,000-inch ranges (NCDENR, 2008). The Courthouse Bay Amphibious Area (including the Former 1,000-inch Range) is

used by the Amphibian Assault Battalion to evaluate track vehicle performance and is part of the Joint College Training Area.

2.3 Previous Investigations

Based on the archival records search results and discussions with Base personnel, no known previous environmental investigations have occurred in the Former 1,000-inch Range area of the Courthouse Bay Amphibious Area.

2.4 Regional Climate

The climate in the MCB CamLej area is characterized by short, mild winters with occasional short-duration cold periods and long, hot, humid summers. Average annual net precipitation is approximately 50 inches. Ambient air temperatures generally range from 33 to 53 degrees Fahrenheit (°F) in the winter months, and from 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, 1983). The hurricane season begins on June 1 and continues through November 30. Storms of non-tropical origins, such as frontal passages, local thunderstorms, and tornadoes, are more frequent and can occur year-round.

2.5 Regional Physiography, Surface Water Hydrology, Geology, and Hydrogeology

MCB CamLej lies within the Tidewater region of the Atlantic Coastal Plain Physiographic Province of North Carolina and is characterized by stepped terraces consisting of wide, gently eastward-sloping plains separated by linear, steeper, northward- and eastward-facing scarps. **Figure 2-2** shows the physiographic provinces of eastern North Carolina (Cardinell, Berg, and Lloyd, 1993). Ground surface elevations typically range from sea level to approximately 70 feet above mean sea level (amsl), with most of the topography within MCB CamLej ranging from 20 to 40 feet amsl. The Base is bisected by the New River and its tributaries in a northwest to southeast alignment.

The regional stratigraphic framework of the Lower Coastal Plain in North Carolina is summarized by **Table 2-1**. Three of the upper Tertiary Formations (Yorktown, Eastover, and Pungo River), shown on **Table 2-1**, are not present in the vicinity of MCB CamLej (Cardinell, Berg, and Lloyd, 1993). The Base is underlain by an eastward thickening sediment wedge of marine and non-marine origins ranging in age from early Cretaceous to Holocene. The sedimentary deposits begin at the western boundary of the Atlantic Coastal Plain physiographic province (known as the Fall Line) and dip southeastward towards the coast. Along the coastline, several thousand feet of interlayered, unconsolidated sediments are present consisting of gravel, sand, silt, clay deposits, calcareous clays, shell beds, sandstone, and limestone that was deposited over pre-Cretaceous crystalline basement rock. Within the MCB CamLej area, approximately 1,500 feet of a sedimentary sequence overlie the crystalline basement rock. This sedimentary sequence is composed of seven aquifers and their associated confining units (less-permeable beds of clay and silt) including the Surficial,

Castle Hayne, Beaufort, Peedee, Black Creek, and Upper and Lower Cape Fear aquifers shown in **Table 2-1** (Cardinell, Berg, and Lloyd, 1993).

Interstream areas generally provide the recharge for aquifers within the Coastal Plain region, and have been estimated to have a yearly recharge from rainfall ranging from 5 to 21 inches (Heath, 1989). In general, natural discharge of groundwater from the Coastal Plain aquifer system is into streams, swamps, and lakes. Evapotranspiration from the vadose zone and upward leakage through confining units into streams, estuaries, swamps, and even the ocean also contribute to groundwater discharge. Within the vicinity of MCB CamLej, the New River estuary serves as the principal discharge area for groundwater from the Castle Hayne aquifer (Harned, 1989).

2.6 Site Characteristics

The Former 1,000-inch Range encompasses approximately 9 acres of partially wooded and heavily tracked land situated at the northern terminus of a north-south trending ridge overlooking Courthouse Bay (**Figure 2-3**). The site elevation ranges from 10 to 25 feet amsl, sloping steeply to the east toward an unnamed tributary of the New River. Surface water was not encountered within the boundaries of the Former 1,000-inch Range during the field activities, although wetlands were observed beyond the eastern and northern site boundaries. It is anticipated that surface runoff would flow toward the wetland areas located north and east of the site.

Intrusive sampling activities conducted during the PA/SI were limited to 6 feet bgs, but indicate that the site is underlain by deposits of Holocene- and Pleistocene-age sediments consisting of fine-grained sands and minor amounts of silt and clay, to depths of at least 6 feet bgs. A layer of plastic, stiff, gray clay was encountered in a low-lying area in the vicinity of the southern site boundary, at a depth of 2 to 3 feet bgs. Due to the generally higher ground surface elevations elsewhere on the site, intrusive activities did not extend to the depths required to determine whether the clay layer was laterally continuous throughout the site.

The depth to groundwater in soil borings was found to range from as shallow as 1 foot bgs in the southeastern portion of the site, to greater than 6 feet bgs in the north-central portion of the site.

TABLE 2-1
Hydrostratigraphic Units of the North Carolina Coastal Plain
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Geologic Units			Hydrogeologic Units
System	**Series**	**Formation**	**Aquifer and Confining Unit**
Quaternary	Holocene/Pleistocene	Undifferentiated	Surficial Aquifer
Tertiary	Miocene	Yorktown[1]	Yorktown confining unit
			Yorktown Aquifer
		Eastover[1]	Pungo River confining unit
		Pungo River[1]	Pungo River Aquifer
		Belgrade[2]	Castle Hayne confining unit
	Oligocene	River Bend	Castle Hayne Aquifer
			Beaufort confining unit[3]
			Beaufort Aquifer
	Eocene	Castle Hayne	Peedee Confining Unit
	Paleocene	Beaufort	
Cretaceous	Upper Cretaceous	Peedee	Black Creek confining unit
		Black Creek and Middendorf	Black Creek Aquifer
			Upper Cape Fear confining unit
		Cape Fear	Upper cape Fear Aquifer
			Lower Cape Fear confining unit
			Lower Cape Fear Aquifer
	Lower Cretaceous	Unnamed deposits[1]	Lower Cretaceous confining unit
			Lower Cretaceous
Pre-Cretaceous basement rocks			

Notes:

[1]Geologic and hydrologic units probably not present beneath MCB Camp Lejeune

[2]Constitutes part of the surficial aquifer and Castle Hayne confining unit in the study area.

[3]Estimated to be confined to deposits of Paleocene age in the study area.

Source: Harned et al., 1989.

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Legend

- Former 1,000-inch Small Arms Range
- Courthouse Bay Amphibious Area
- Installation Boundary

N

0 250 500 1,000 Feet

1 inch = 500 feet

Figure 2-1
Site Map
PA/SI Report for the Former 1,000-inch Range (Amphibious Base Area) - UXO15
MCB CamLej
North Carolina

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Source: USGS Report by Cardinell, A.P., S.A. Berg, and O.B. Lloyd, Jr. (1993)

Figure 2-2
Physiographic Provinces of Eastern North Carolina
1,000-Inch Range (Amphibious Base Area) – UXO-15
PA/SI Report
MCB CamLej, North Carolina

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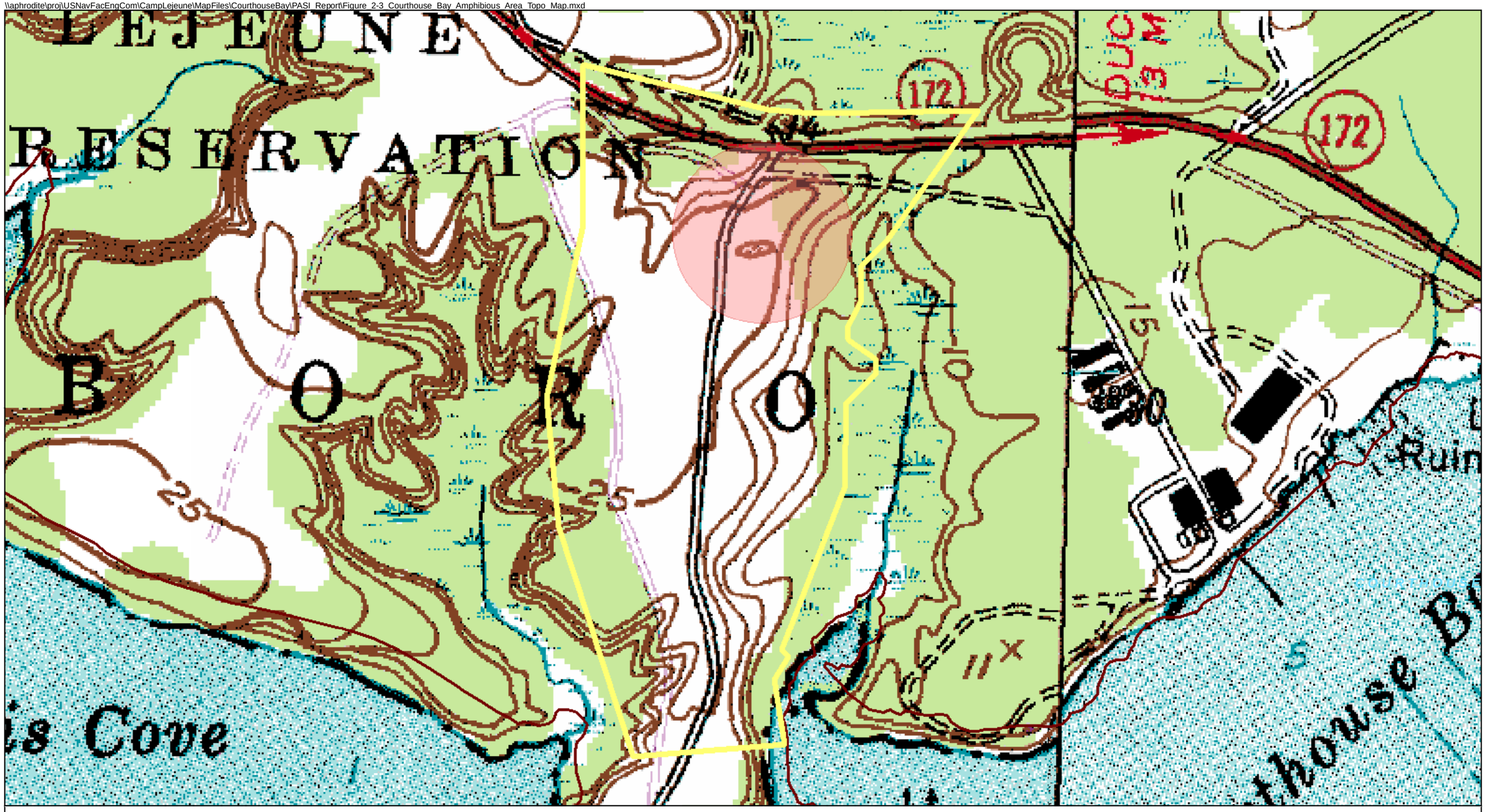

Legend
- Former 1,000-inch Small Arms Range
- Courthouse Bay Amphibious Area
- Installation Boundary

N

0 200 400 800 Feet

1 inch = 400 feet

Figure 2-3
Topographical Map
PA/SI Report for the Former 1,000-Inch
Range (Amphibious Base Area) - UXO-15
MCB CamLej
North Carolina

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SECTION 3

Field Investigation Activities and Data Evaluation

3.1 Field Investigation Activities

The PA/SI field activities were conducted in September and December 2008, in accordance with Standard Operating Procedures (SOPs) outlined in the *Work Plan Preliminary Assessment/Site Inspection – 1,000-Inch Range (Amphibious Base Area) – UXO-15, Marine Corps Base Camp Lejeune, North Carolina* (CH2M HILL, 2008c). These procedures are detailed in the Master Project Plans (CH2M HILL, 2008a). All sampling locations are shown in **Figure 3-1**.

3.1.1 Utility Clearance

Prior to initiating the intrusive investigation activities, all buried utilities were identified within a 20-foot radius of each proposed sampling location. Utility locating services were provided by Taylor Wiseman & Taylor of Raleigh, North Carolina.

3.1.2 Site Survey

To establish the site boundaries and locate the proposed sampling locations, a North Carolina-licensed surveyor (Lanier Surveying) was retained. The surveyor identified the center points of each of the 0.25-acre sample grids, as shown in **Figure 3-1**, in accordance with Section 3.3 of the Master Project Plans (CH2M HILL, 2008a).

The surveyor provided coordinates for each sampling location referenced horizontally to permanent land monuments. The survey controls were tied to North American Datum of 1983 (NAD83) Universal Transverse Mercator (UTM), Zone 18, meters. The ground surface horizontal control was surveyed to the nearest 0.10 foot.

3.1.3 Vegetation Clearing

Due to the presence of dense brush surrounding several of the proposed sampling locations, vegetation less than 1 inch in diameter was cleared and mulched in place to provide access. In total, an estimated 0.25 acres (or less) required clearing. Vegetation clearing was accomplished using a combination of nonintrusive mechanical and manual methods. Vegetation larger than approximately 1 inch in diameter was left undisturbed.

3.1.4 Soil Sampling

The field sampling activities were conducted on September 9, 2008, and December 10 through 13, 2008. The 9-acre investigation area was subdivided into 64 sample grids measuring approximately 0.25 acres each, as shown by **Figure 3-1**. A total of 64 composite surface soil samples (designated ASR2.19-SS01 to ASR2.19-SS64) were collected from 0 to 1 foot bgs from each of the sample grids in accordance with Section 3.11.1 of the Master Sampling and Analysis Plan. Each surface soil sample consisted of five aliquots collected

throughout the sample grid (four composite sample locations and center sample location) as shown in **Figure 3-1**. A total of 64 subsurface soil samples (designated ASR2.19-SB01 to ASR2.19-SB64) were collected from the center of each sample grid from a maximum depth of 5 to 6 feet bgs (or 0.5 foot above the water table).

Figure 3-1 illustrates the northeast portion of the site where grading activities associated with the construction of a parking lot were initiated prior to the start of the environmental sampling, and resulted in the removal of surface and subsurface soil to a depth of approximately 5 to 10 feet bgs. To collect samples from the proposed parking lot area prior to its completion, soil samples were collected from this area on September 9, 2008. Consequently, the surface soil samples collected from sample locations ASR2.19-SS46 to -SB47, -53 to -56, and -60 to -64 are more representative of subsurface conditions. Since the materials removed during the grading activities were stockpiled at the northern Courthouse Bay Amphibious Area site boundary, composite soil samples were collected from the stock pile.

The remaining 50 composite surface soil samples were collected from 0 to 1 foot bgs during the December 8 to December 13, 2008 field activities. The sampling procedure involved clearing organic debris to expose the surface soil, followed by collection of sample aliquots from five 1-foot by 1-foot areas to a depth of 1 foot bgs. The five aliquots were then thoroughly mixed and samples were placed in laboratory supplied containers for shipment under chain-of-custody control for analysis by Empirical Laboratories and Test America. Each sample was analyzed for select metals (antimony, arsenic, copper, lead, and zinc) by USEPA Method 6010B/6020 and perchlorate by USEPA Method 6850 in accordance with the Interstate Technology and Regulatory Council (ITRC) guidance for assessment of small arms ranges (ITRC, 2003).

Subsurface soil samples were collected from the center of each grid using a hand auger (**Figure 3-1**). The soil cuttings were described in the field using the Unified Soil Classification System and recorded in the filed notes. The subsurface soil samples were collected from a depth of 5 to 6 feet bgs (or 0.5 foot above the water table). The subsurface soil samples were packaged, shipped, and analyzed in the same manner as the surface soil samples.

All soil samples were placed in laboratory-prepared, appropriately labeled containers, immediately packed on ice in coolers, and shipped via FedEx delivery to Empirical Laboratories, LLC, Nashville, Tennessee for metals analysis and to Test America, Sacramento, California for perchlorate analysis. Soil samples remained in the presence of a CH2M HILL project representative until delivery to the FedEx location. A COC document was used to maintain a record of personnel who had control of the samples (**Appendix A**).

3.1.5 Quality Assurance/Quality Control Sampling

Appropriate quality assurance/quality control (QA/QC) sampling was performed in accordance with the *Quality Assurance Project Plan Preliminary Assessment/Site Inspection– 1,000-Inch Range (Amphibious Base Area) – UXO-15* found as **Appendix B** of the PA/SI work plan (CH2M HILL, 2008c), including trip blanks, field blanks, equipment blanks, duplicates, and matrix spike/matrix spike duplicates (MS/MSDs).

3.2 Investigation-derived Waste Handling

All investigation-derived waste (IDW) was disposed of onsite in accordance with the Base Waste Management Plan (CH2M HILL, 2008b). The IDW generated during field events consisted of soil cuttings from the surface and subsurface soil sampling, decontamination fluids, disposable equipment, and personal protective equipment (PPE). Soil cuttings were returned to the borehole location after the sample was collected. Decontamination fluids were collected in 5-gallon buckets and disposed of at the water treatment facility located at Lot 203 of MCB CamLej. Disposable materials—including PPE, plastic sheeting and bags, paper towels, and aluminum foil—were disposed of in onsite trash receptacles.

3.3 Data Evaluation

This section discusses the management and evaluation of analytical data collected during the PA/SI. This includes data tracking and validation, evaluation of non-site-related analytical results, discussion of the regulatory and risk-based standards, and data presentation and evaluation.

3.3.1 Data Tracking and Validation

The management and tracking of data from the time of field collection to receipt of validated electronic analytical results reflects the overall quality of the analytical results. Field samples and their corresponding analytical tests were recorded on chain-of-custody forms, which were submitted with the samples to the laboratory. Chain-of-custody entries were checked against the *Work Plan Preliminary Assessment/Site Inspection 1,000-Inch Range (Amphibious Base Area) – UXO-15* (CH2M HILL, 2008c) to verify that all proposed samples were collected and submitted for the appropriate analyses. Upon receipt of the samples by the laboratories, a comparison to the field information was made to verify that each sample was analyzed for the correct parameters. In addition, a check was made to ensure that the proper number and types of QA/QC samples were collected. QA/QC samples included field blanks, equipment blanks, trip blanks, duplicates, MS/MSD samples, and laboratory blanks.

Analytical data reports, in hard copy and electronic format, were submitted for third-party validation. Procedures used for the validation process were *National Functional Guidelines for Organic Data Review* (USEPA, 1999), and *National Functional Guidelines for Inorganic Data Review* (USEPA, 2004b). The electronic data was downloaded into the CH2M HILL Endat database. These steps (third-party validation and electronic data handling) serve to reduce inherent uncertainties associated with data authenticity and usability.

3.3.2 Data Evaluation

The preliminary data was screened against USEPA Residential Soil Adjusted Regional Screening Level (RSLs) (USEPA, 2008), the North Carolina Department of Environment and Natural Resources Federal Remediation Branch Protection of Groundwater Preliminary Soil Remediation Goals (PSRGs) (NCDENR, 2010), and 2x Base background concentrations for metals (Baker, 2001). PSRGs\ are chemical-specific screening levels for the protection of human health and the groundwater used for drinking (NCDENR, 2010). For constituents

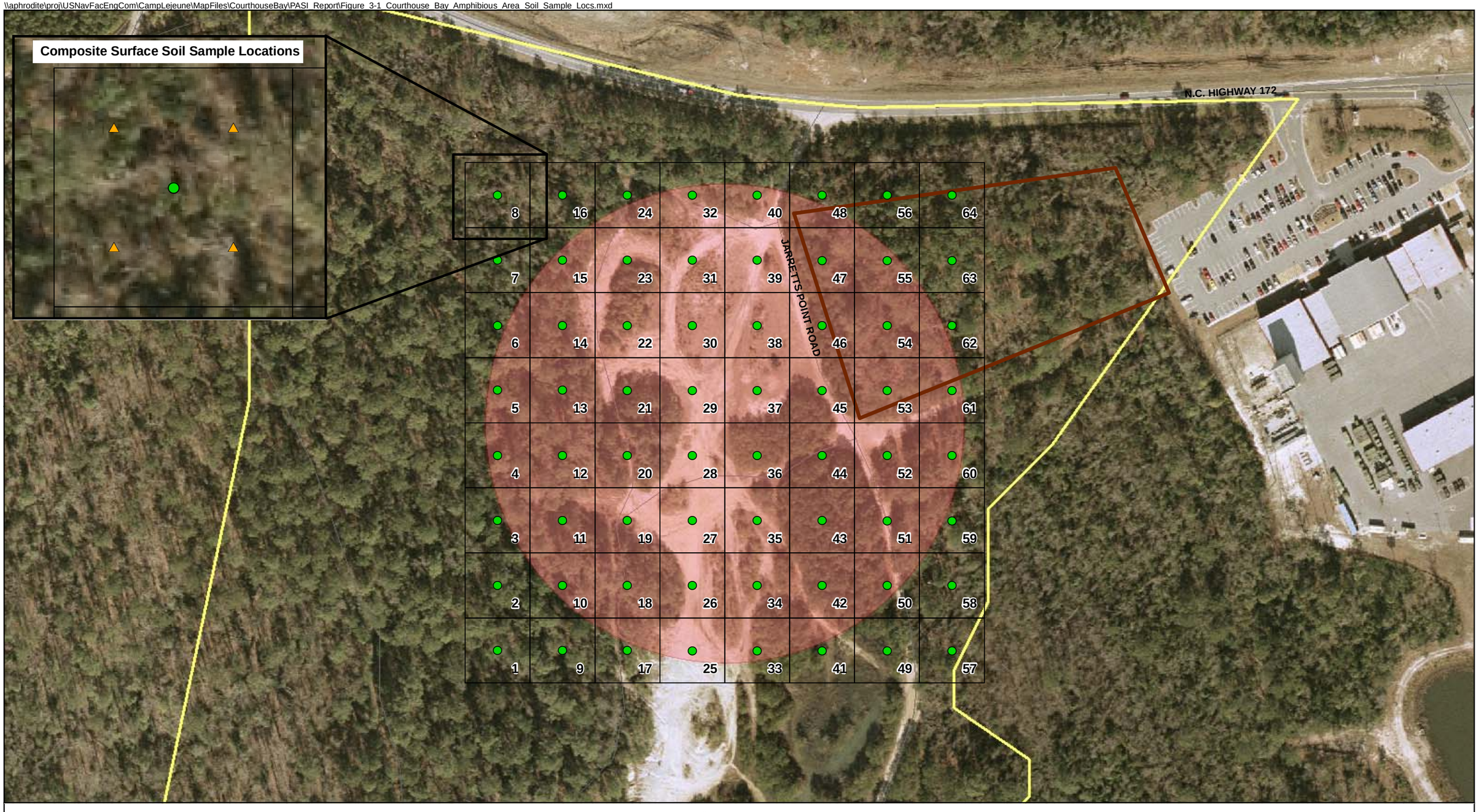
with both human health and protection of groundwater PSRGs, the more conservative of the two values will be used.

Additionally, to identify constituents present in site media that could be reflective of a potential site-related release, naturally occurring and anthropogenic compounds (metals) detected at each site were compared to available Basewide background data. The results are discussed in Section 4.

The data collected during the PA/SI was evaluated using a conservative screening process to evaluate whether site-related compounds were present at levels that could pose a risk to exposed human and ecological receptors.

The human health and ecological screening process and results are described in Sections 5 and 6, respectively.

\\aphrodite\proj\USNavFacEngCom\CampLejeune\MapFiles\CourthouseBay\PASI_Report\Figure_3-1_Courthouse_Bay_Amphibious_Area_Soil_Sample_Locs.mxd



Legend

- Composite Soil Sampling Location
- Subsurface Soil Sampling Location
- Proposed Parking Lot for 202K Initiative
- Former 1000-inch Small Arms Range
- Courthouse Bay Amphibious Area

N

0 75 150 300 Feet

1 inch = 150 feet

Figure 3-1
Soil Sampling Locations
PA/SI Report for the Former 1,000-Inch
Range (Amphibious Base Area) - UXO-15
MCB CamLej
North Carolina

CH2MHILL

SECTION 4

Results

This section presents the findings of field sampling activities conducted during the Former 1,000-inch Range PA/SI. Target analytes that were detected at concentrations exceeding Base background concentrations and screening criteria in surface and subsurface soil are summarized in **Tables 4-1** and **4-2** and are shown on **Figures 4-1** and **4-2**.

4.1 Surface Soil

Surface soil data were compared to USEPA Residential Soil Adjusted RSLs, PSRGs, and 2× Base background. Surface soil analytical results are summarized in **Table 4-1**, while surface soil exceedances are depicted by **Figure 4-1**.

Metals. Arsenic was the only metal that was detected at concentrations greater than the Residential RSL and 2x Base background. Analytical results are summarized as follows:

- Arsenic concentrations ranged from 0.26 milligrams per kilogram (mg/kg) to 2.1 mg/kg.
- Arsenic exceeds Residential RSL (0.39 mg/kg) and 2x Base background (0.626 mg/kg). Sample Grids 1 through 10, 12 through 28, 34, 36, 42, 44, 45, 48, 49, 51, 54, 57, 60, and 63.
- All arsenic detections were less than the PSRG of 5.8 mg/kg.

Perchlorate was not detected in any surface soil samples at concentrations above the laboratory reporting limit (RL).

The soil samples collected from the stockpiled soil (both surface and subsurface soil in the parking lot construction area), did not contain any target analytes at concentrations exceeding background concentrations.

4.2 Subsurface Soil

Subsurface soil concentrations were screened against adjusted Residential Soil RSLs, PSRGs, and 2× Base background. Subsurface soil analytical results are presented in **Table 4-2**. Subsurface soil exceedances are also presented on **Figure 4-2**.

Metals. Arsenic and antimony were the only metals that were detected at concentrations greater than the Residential RSL, 2x Base background, and PSRG screening levels. Analytical results are summarized as follows:

- Arsenic concentrations ranged from 0.21 mg/kg to 17.4 mg/kg.
- Arsenic exceeds Residential RSL (0.39 mg/kg), 2x Base background (2.12 mg/kg), and PSRG (5.8 mg/kg) at two locations. Sample Grids 27 and 33.

- Antimony concentrations ranged from 0.78 mg/kg to 10.4 mg/kg.
- Antimony exceeds Residential RSL (3.1 mg/kg) and 2x Base background (0.36 mg/kg), at one location with an estimated concentration of 10.4 J. Sample Grid 57.

Perchlorate was not detected in any surface soil samples above the laboratory RL.

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**PSRG (January 2010)**	**Camp Lejeune Background SS 2X Mean**	ASR2.19-SS01	ASR2.19-SS02	ASR2.19-SS03	ASR2.19-SS04	ASR2.19-SS05		ASR2.19-SS06	ASR2.19-SS07	ASR2.19-SS08
Sample ID				ASR2.19-SS01-0-1-08D	ASR2.19-SS02-0-1-08D	ASR2.19-SS03-0-1-08D	ASR2.19-SS04-0-1-08D	ASR2.19-SS05-0-1-08D	ASR2.19-SS05D-0-1-08D	ASR2.19-SS06-0-1-08D	ASR2.19-SS07-0-1-08D	ASR2.19-SS08-0-1-08D
Sample Date				12/10/08	12/10/08	12/10/08	12/11/08	12/11/08	12/11/08	12/11/08	12/11/08	12/11/08
Chemical Name												
Explosives (µg/kg)												
Perchlorate	5,500	NS	--	2.3 U	2.3 U	2.7 U	3 U	2.4 U	2.4 U	3 U	2.5 U	2.6 U
Total Metals (mg/kg)												
Antimony	3.1	NS	0.447	0.96 UJ	0.85 UJ	0.84 UJ	0.86 UJ	0.9 UJ	0.89 UJ	0.88 UJ	0.94 UJ	0.97 UJ
Arsenic	0.39	5.8	0.626	**0.7**	**0.68**	**0.99**	**1**	**1.3**	**1.4**	**0.7 J**	**1.5 J**	**1.9 J**
Copper	310	700	4.83	1.2 J	2.4	0.45 J	2	2.5	2.6	0.89 J	1.1 J	4.5
Lead	400	270	12.3	6.7	6.4	7.7	8.1	8.7	8.6	7.4	10.7	**29.6**
Zinc	2,300	1,200	10.8	3.9	4.2	2.9	2.9	6.8	7.7	3.8 J	4.7 J	**14.2 J**

Notes:

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

NA - Not analyzed

U - The material was analyed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

Shading indicates exceedance of Residential RSLs

Bold text indicates exceedance of Camp Lejeune Background criteria

PRSG - North Carolina Department of Environment and Natural Resources

Federal Remediation Branch Protection of Groundwater Preliminary

Soil Remediation Goals (January 2010)

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**PSRG (January 2010)**	**Camp Lejeune Background SS 2X Mean**	ASR2.19-SS09	ASR2.19-SS10	ASR2.19-SS11	ASR2.19-SS12	ASR2.19-SS13	ASR2.19-SS14	ASR2.19-SS15	ASR2.19-SS16
Sample ID				ASR2.19-SS09-0-1-08D	ASR2.19-SS10-0-1-08D	ASR2.19-SS11-0-1-08D	ASR2.19-SS12-0-1-08D	ASR2.19-SS13-0-1-08D	ASR2.19-SS14-0-1-08D	ASR2.19-SS15-0-1-08D	ASR2.19-SS16-0-1-08D
Sample Date				12/11/08	12/11/08	12/11/08	12/11/08	12/11/08	12/12/08	12/12/08	12/12/08
Chemical Name											
Explosives (µg/kg)											
Perchlorate	5,500	NS	--	3 U	2.4 U	2.6 U	3 U	2.7 U	2.4 U	2.3 U	2.3 U
Total Metals (mg/kg)											
Antimony	3.1	NS	0.447	0.87 UJ	0.87 UJ	0.91 UJ	0.83 UJ	0.85 UJ	0.86 UJ	0.89 UJ	0.87 UJ
Arsenic	0.39	5.8	0.626	**0.67 J**	**0.82 J**	0.55 J	**0.83 J**	**0.69 J**	**1.3 J**	**1.2 J**	0.5 J
Copper	310	700	4.83	0.7 J	2.7	1.7	1.1 J	0.77 J	1.8	2.9	0.72 J
Lead	400	270	12.3	6.6	11	5.4	12.1	6.6	5.9	7.2	9.7
Zinc	2,300	1,200	10.8	2.8 J	7.6 J	4.5 J	6 J	3.9 J	5.7 J	**17.6 J**	4

Notes:
J - Analyte present, value may or may not be accurate or precise
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Shading indicates exceedance of Residential RSLs
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PRSG - North Carolina Department of Environment and Natural Resources
Federal Remediation Branch Protection of Groundwater Preliminary
Soil Remediation Goals (January 2010)

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**PSRG (January 2010)**	**Camp Lejeune Background SS 2X Mean**	ASR2.19-SS17		ASR2.19-SS18	ASR2.19-SS19	ASR2.19-SS20	ASR2.19-SS21	ASR2.19-SS22	ASR2.19-SS23	ASR2.19-SS24
Sample ID				ASR2.19-SS17-0-1-08D	ASR2.19-SS17D-0-1-08D	ASR2.19-SS18-0-1-08D	ASR2.19-SS19-0-1-08D	ASR2.19-SS20-0-1-08D	ASR2.19-SS21-0-1-08D	ASR2.19-SS22-0-1-08D	ASR2.19-SS23-0-1-08D	ASR2.19-SS24-0-1-08D
Sample Date				12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08
Chemical Name												
Explosives (µg/kg)												
Perchlorate	5,500	NS	--	2.3 U	2.3 U	2.3 U	2.3 U	2.3 U	2.4 U	2.3 U	2.3 U	2.3 U
Total Metals (mg/kg)												
Antimony	3.1	NS	0.447	0.86 UJ	0.87 UJ	0.87 UJ	0.86 UJ	0.83 UJ	0.85 UJ	0.87 UJ	0.89 UJ	0.82 UJ
Arsenic	0.39	5.8	0.626	**1.1**	**1.6**	**0.69**	**1.3**	**0.84**	**1**	**1.5**	**2.1**	**0.87**
Copper	310	700	4.83	0.81 J	0.86 J	0.51 J	1.1 J	0.83 J	0.51 J	0.78 J	0.61 J	0.53 J
Lead	400	270	12.3	3.3	3.1	2.3	3.3	3.7	2.7	3.3	2.9	3
Zinc	2,300	1,200	10.8	3.4	3.4	2.5	3.9	3.2	2.3	3.6	2	2.7

Notes:

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PRSG - North Carolina Department of Environment and Natural Resources

Federal Remediation Branch Protection of Groundwater Preliminary

Soil Remediation Goals (January 2010)

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**PSRG (January 2010)**	**Camp Lejeune Background SS 2X Mean**	ASR2.19-SS25	ASR2.19-SS26	ASR2.19-SS27	ASR2.19-SS28	ASR2.19-SS29	ASR2.19-SS30	ASR2.19-SS31	ASR2.19-SS32	
Sample ID				ASR2.19-SS25-0-1-08D	ASR2.19-SS26-0-1-08D	ASR2.19-SS27-0-1-08D	ASR2.19-SS28-0-1-08D	ASR2.19-SS29-0-1-08D	ASR2.19-SS30-0-1-08D	ASR2.19-SS31-0-1-08D	ASR2.19-SS32-0-1-08D	ASR2.19-SS32D-0-1-08D
Sample Date				12/12/08	12/13/08	12/13/08	12/13/08	12/13/08	12/13/08	12/13/08	12/13/08	12/13/08
Chemical Name												
Explosives (µg/kg)												
Perchlorate	5,500	NS	--	2.3 U	2.3 U	2.4 U	2.4 U	2.4 U	2.3 U	2.2 U	2.2 U	2.2 U
Total Metals (mg/kg)												
Antimony	3.1	NS	0.447	0.87 UJ	0.87 UJ	0.9 UJ	0.89 UJ	0.89 UJ	0.86 UJ	0.81 UJ	0.81 UJ	0.8 UJ
Arsenic	0.39	5.8	0.626	**0.95**	**0.91**	**0.73**	**1.4**	0.39 J	0.55 J	0.49 J	0.44 J	0.4 J
Copper	310	700	4.83	0.5 J	0.31 J	0.56 J	0.5 J	1.5 U	0.89 J	0.28 J	1.3 J	1.3 J
Lead	400	270	12.3	2	1.8	2.3	2.7	1.2	3.4	1.7	4.5	4.6
Zinc	2,300	1,200	10.8	2.4	1.9	3	3	1.3	3.4	2	6.6	5.9

Notes:

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Federal Remediation Branch Protection of Groundwater Preliminary

Soil Remediation Goals (January 2010)

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**PSRG (January 2010)**	**Camp Lejeune Background SS 2X Mean**	ASR2.19-SS33	ASR2.19-SS34	ASR2.19-SS35	ASR2.19-SS36		ASR2.19-SS37	ASR2.19-SS38	ASR2.19-SS39	ASR2.19-SS40
Sample ID				ASR2.19-SS33-0-1-08D	ASR2.19-SS34-0-1-08D	ASR2.19-SS35-0-1-08D	ASR2.19-SS36-0-1-08D	ASR2.19-SS36D-0-1-08D	ASR2.19-SS37-0-1-08D	ASR2.19-SS38-0-1-08D	ASR2.19-SS39-0-1-08D	ASR2.19-SS40-0-1-08D
Sample Date				12/10/08	12/10/08	12/10/08	12/10/08	12/10/08	12/10/08	12/10/08	12/10/08	12/10/08
Chemical Name												
Explosives (µg/kg)												
Perchlorate	5,500	NS	--	2.4 U	2.3 U	2.3 U	2.5 U	2.5 U	2.2 U	2.1 U	2.2 U	2.1 U
Total Metals (mg/kg)												
Antimony	3.1	NS	0.447	0.9 UJ	0.88 UJ	0.88 UJ	0.89 UJ	0.87 UJ	0.82 UJ	0.8 UJ	0.84 UJ	0.81 UJ
Arsenic	0.39	5.8	0.626	0.36	**1.1**	0.49 J	**0.63**	0.47 J	0.28 J	0.43 J	0.59	0.34 J
Copper	310	700	4.83	1.5 U	0.45 J	1.5 U	1.5 U	1.5 U	1.4 U	1.3 U	1.1 J	1.1 J
Lead	400	270	12.3	1.3	2.1	1.4	1.7	1.1	1.3	2.1	4.6	7.3
Zinc	2,300	1,200	10.8	1.8	2.7	2	2.5	1.9	1.6	2	5.5	**40.1**

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Federal Remediation Branch Protection of Groundwater Preliminary

Soil Remediation Goals (January 2010)

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**PSRG (January 2010)**	**Camp Lejeune Background SS 2X Mean**	ASR2.19-SS41	ASR2.19-SS42	ASR2.19-SS43	ASR2.19-SS44	ASR2.19-SS45	ASR2.19-SS46	ASR2.19-SS47	ASR2.19-SS48	ASR2.19-SS49
Sample ID				ASR2.19-SS41-0-0.5-08D	ASR2.19-SS42-0-1-08D	ASR2.19-SS43-0-1-08D	ASR2.19-SS44-0-1-08D	ASR2.19-SS45-0-1-08C	ASR2.19-SS46-0-1-08C	ASR2.19-SS47-0-1-08C	ASR2.19-SS48-0-1-08C	ASR2.19-SS49-0-1-08D
Sample Date				12/13/08	12/13/08	12/13/08	12/13/08	09/10/08	09/10/08	09/10/08	09/10/08	12/13/08
Chemical Name												
Explosives (µg/kg)												
Perchlorate	5,500	NS	--	2.4 U	2.3 U	2.2 U	2.4 U	NA	NA	NA	NA	2.4 U
Total Metals (mg/kg)												
Antimony	3.1	NS	0.447	0.93 UJ	0.88 UJ	0.84 UJ	0.88 UJ	0.87 UJ	0.88 UJ	0.81 UJ	0.86 UJ	**0.46 J**
Arsenic	0.39	5.8	0.626	0.35 J	**1.6**	0.38 J	**0.79**	**0.72**	0.59	0.33 J	**0.64**	**1.5**
Copper	310	700	4.83	1.5 U	1.6	0.64 J	1.4 J	1.2 J	1 J	0.77 J	4.5	4
Lead	400	270	12.3	1.9	11	2.8	5.4	3.5	3.1	3.1	6.4	**21.5**
Zinc	2,300	1,200	10.8	1.6	**11.2**	2.1	6.7	9.5 J	4.1 J	2.9 J	**11.7 J**	**16.3**

Notes:
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Bold text indicates exceedance of Camp Lejeune Background criteria
PRSG - North Carolina Department of Environment and Natural Resources
Federal Remediation Branch Protection of Groundwater Preliminary
Soil Remediation Goals (January 2010)

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**PSRG (January 2010)**	**Camp Lejeune Background SS 2X Mean**	ASR2.19-SS50	ASR2.19-SS51	ASR2.19-SS52	ASR2.19-SS53	ASR2.19-SS54	ASR2.19-SS55	ASR2.19-SS56	ASR2.19-SS57
Sample ID				ASR2.19-SS50-0-1-08D	ASR2.19-SS51-0-1-08D	ASR2.19-SS52-0-1-08C	ASR2.19-SS53-0-1-08C	ASR2.19-SS54-0-1-08C	ASR2.19-SS55-0-1-08C	ASR2.19-SS56-0-1-08C	ASR2.19-SS57-0-1-08D
Sample Date				12/13/08	12/13/08	09/10/08	09/10/08	09/10/08	09/10/08	09/10/08	12/13/08
Chemical Name											
Explosives (µg/kg)											
Perchlorate	5,500	NS	--	2.3 U	2.2 U	NA	NA	NA	NA	NA	2.4 U
Total Metals (mg/kg)											
Antimony	3.1	NS	0.447	0.82 UJ	0.84 UJ	0.83 UJ	0.95 UJ	0.77 UJ	0.83 UJ	0.97 UJ	0.9 UJ
Arsenic	0.39	5.8	0.626	0.53 J	**1**	0.51 J	0.44 J	**0.73**	**0.8**	0.49 J	**0.94**
Copper	310	700	4.83	1.3 J	1.8	0.91 J	0.83 J	0.7 J	0.57 J	0.9 J	2.1
Lead	400	270	12.3	5.1	6.9	3.3	2.9	2.4	2.6	4.2	10
Zinc	2,300	1,200	10.8	4.6	6.5	3.8 J	3.3 J	2.8 J	2.1 J	3.4 J	5.8

Notes:
J - Analyte present, value may or may not be accurate or precise
NA - Not analyzed
U - The material was analyed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
Shading indicates exceedance of Residential RSLs
Bold text indicates exceedance of Camp Lejeune Background criteria
PRSG - North Carolina Department of Environment and Natural Resources
Federal Remediation Branch Protection of Groundwater Preliminary
Soil Remediation Goals (January 2010)

TABLE 4-1
Surface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	RSLs Residential Soil Adjusted	PSRG (January 2010)	Camp Lejeune Background SS 2X Mean	ASR2.19-SS58		ASR2.19-SS59	ASR2.19-SS60		ASR2.19-SS61	ASR2.19-SS62	ASR2.19-SS63	ASR2.19-SS64
Sample ID				ASR2.19-SS58-0-1-08D	ASR2.19-SS58D-0-1-08D	ASR2.19-SS59-0-1-08D	ASR2.19-SS60-0-1-08C	ASR2.19-SS60D-0-1-08C	ASR2.19-SS61-0-1-08C	ASR2.19-SS62-0-1-08C	ASR2.19-SS63-0-1-08C	ASR2.19-SS64-0-1-08C
Sample Date				12/13/08	12/13/08	12/13/08	09/10/08	09/10/08	09/10/08	09/10/08	09/10/08	09/10/08
Chemical Name												
Explosives (µg/kg)												
Perchlorate	5,500	NS	--	2.2 U	2.3 U	2.4 U	NA	NA	NA	NA	NA	NA
Total Metals (mg/kg)												
Antimony	3.1	NS	0.447	0.81 UJ	0.82 UJ	0.88 UJ	0.87 UJ	0.39 J	0.95 UJ	0.83 UJ	0.86 UJ	0.99 UJ
Arsenic	0.39	5.8	0.626	0.48 J	0.6	0.44 J	**1.1**	**0.91**	0.45 J	0.61	**0.86**	0.54 J
Copper	310	700	4.83	2.1	1.7	1.3 J	1.6 J	**13.9 J**	1 J	0.9 J	0.56 J	0.71 J
Lead	400	270	12.3	5	4.9	4.7	4.8	10.3	3.3	3.7	2.3	3.8
Zinc	2,300	1,200	10.8	2.5	2.6	5.2	8.9 J	**21.2 J**	3.4 J	3.7 J	2.1 J	2.5 J

Notes:
J - Analyte present, value may or may not be accurate or precise
NA - Not analyzed
U - The material was analyed for, but not detected
UJ - Analyte not detected, quantitation limit may be inaccurate
Shading indicates exceedance of Residential RSLs
Bold text indicates exceedance of Camp Lejeune Background criteria
PRSG - North Carolina Department of Environment and Natural Resources
Federal Remediation Branch Protection of Groundwater Preliminary
Soil Remediation Goals (January 2010)

TABLE 4-2
Subsurface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**NC PSRG (January 2010)**	**Camp Lejeune Background SB 2X Mean**	ASR2.19-SB01	ASR2.19-SB02	ASR2.19-SB03	ASR2.19-SB04	ASR2.19-SB05		ASR2.19-SB06	ASR2.19-SB07	ASR2.19-SB08
Sample ID				ASR2.19-SB01-5-6-08D	ASR2.19-SB02-5-6-08D	ASR2.19-SB03-5-6-08D	ASR2.19-SB04-5-6-08D	ASR2.19-SB05-5-6-08D	ASR2.19-SB05D-5-6-08D	ASR2.19-SB06-5-6-08D	ASR2.19-SB07-5-6-08D	ASR2.19-SB08-5-6-08D
Sample Date				12/10/08	12/10/08	12/10/08	12/11/08	12/11/08	12/11/08	12/11/08	12/11/08	12/11/08
Chemical Name												
Explosives (µg/kg)												
Perchlorate	5,500	NS	--	2.2 U	2.4 U	2.4 U	2.5 U	2.5 U	2.6 U	2.6 U	2.6 U	2.4 U
Total Metals (mg/kg)												
Antimony	3.1	NS	0.36	0.81 UJ	0.9 UJ	0.9 UJ	0.84 UJ	0.87 UJ	0.82 UJ	0.79 UJ	0.97 UJ	0.87 UJ
Arsenic	0.39	5.8	2.12	0.76	1.1	**2.7**	0.95	0.57 J	0.31 J	0.53 U	0.21 J	0.29 J
Copper	310	700	2.56	1.5	0.8 J	2.2	0.65 J	0.9 J	1.4 U	1.3 U	1.6 U	0.62 J
Lead	400	270	8.49	5.4	4.7	7.4	5.8	4.3	2.7	1.9	3	4.2
Zinc	2,300	1,200	6.59	**7.2**	6.2	**10.9**	4.7	5.6	2.9	1.2 J	1.3 U	3.3 J

Notes:

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

NA - Not analyzed

NS - No Standard

U - The material was analyed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

Shading indicates exceedance of Residential RSLs

Bold box indicates exceedance of NC PSRG's criteria

Bold text indicates exceedance of Camp Lejeune Background criteria

NC PRSG - North Carolina Department of Environment and Natural Resources

Federal Remediation Branch Preliminary Soil remediation Goals (January 2010)

TABLE 4-2
Subsurface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**NC PSRG (January 2010)**	**Camp Lejeune Background SB 2X Mean**	ASR2.19-SB09	ASR2.19-SB10	ASR2.19-SB11	ASR2.19-SB12	ASR2.19-SB13	ASR2.19-SB14	ASR2.19-SB15	ASR2.19-SB16
Sample ID				ASR2.19-SB09-5-6-08D	ASR2.19-SB10-5-6-08D	ASR2.19-SB11-5-6-08D	ASR2.19-SB12-5-6-08D	ASR2.19-SB13-5-6-08D	ASR2.19-SB14-5-6-08D	ASR2.19-SB15-5-6-08D	ASR2.19-SB16-5-6-08D
Sample Date				12/11/08	12/11/08	12/11/08	12/11/08	12/11/08	12/12/08	12/12/08	12/12/08
Chemical Name											
Explosives (µg/kg)											
Perchlorate	5,500	NS	--	2.5 U	3 U	2.1 U	2.8 U	2.3 U	2.2 U	2.2 U	2.2 U
Total Metals (mg/kg)											
Antimony	3.1	NS	0.36	0.87 UJ	0.84 UJ	0.79 UJ	0.85 UJ	0.87 UJ	0.8 UJ	0.79 UJ	0.83 UJ
Arsenic	0.39	5.8	2.12	1.7 J	1.8 J	0.33 J	1 J	1.5 J	0.68 J	0.38 J	0.6
Copper	310	700	2.56	1.3 J	2.1	0.31 J	1.4 J	1.6	1 J	0.76 J	0.67 J
Lead	400	270	8.49	5.8	6.3	3.2	5.5	5.7	5.1	5.8	5.7
Zinc	2,300	1,200	6.59	**6.7 J**	**9.4 J**	2.5 J	**6.6 J**	**7.2 J**	**6.7 J**	6.2 J	4.4

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Federal Remediation Branch Preliminary Soil remediation Goals (January 2010)

TABLE 4-2
Subsurface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**NC PSRG (January 2010)**	**Camp Lejeune Background SB 2X Mean**	ASR2.19-SB17		ASR2.19-SB18	ASR2.19-SB19	ASR2.19-SB20	ASR2.19-SB21	ASR2.19-SB22	ASR2.19-SB23	ASR2.19-SB24	ASR2.19-SB25
Sample ID				ASR2.19-SB17-5-6-08D	ASR2.19-SB17D-5-6-08D	ASR2.19-SB18-5-6-08D	ASR2.19-SB19-5-6-08D	ASR2.19-SB20-5-6-08D	ASR2.19-SB21-5-6-08D	ASR2.19-SB22-5-6-08D	ASR2.19-SB23-5-6-08D	ASR2.19-SB24-5-6-08D	ASR2.19-SB25-5-6-08D
Sample Date				12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08	12/12/08
Chemical Name													
Explosives (µg/kg)													
Perchlorate	5,500	NS	--	2.1 U	2.1 U	2.3 U	2.3 U	2.2 U	2.2 U	2.4 U	2.4 U	2.2 U	2.5 U
Total Metals (mg/kg)													
Antimony	3.1	NS	0.36	0.78 UJ	0.81 UJ	0.86 UJ	0.88 UJ	0.82 UJ	0.82 UJ	0.89 UJ	0.89 UJ	0.85 UJ	0.92 UJ
Arsenic	0.39	5.8	2.12	0.29 J	0.33 J	0.89	0.89	1.4	0.92	0.72	0.7	0.73	0.42 J
Copper	310	700	2.56	0.65 J	0.35 J	0.88 J	0.53 J	1.5	**11.4**	0.77 J	0.75 J	0.9 J	1.5 U
Lead	400	270	8.49	3.6	2.7	6.3	2.4	5.4	1.6	2.8	2.8	4.2	1.2
Zinc	2,300	1,200	6.59	2.5	1.7	5.9	2.3	4.3	2.6	2	3.4	3.7	2.5

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Federal Remediation Branch Preliminary Soil remediation Goals (January 2010)

TABLE 4-2
Subsurface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**NC PSRG (January 2010)**	**Camp Lejeune Background SB 2X Mean**	ASR2.19-SB26	ASR2.19-SB27	ASR2.19-SB28	ASR2.19-SB29	ASR2.19-SB30	ASR2.19-SB31	ASR2.19-SB32		ASR2.19-SB33	ASR2.19-SB34
Sample ID				ASR2.19-SB26-2-3-08D	ASR2.19-SB27-2-3-08D	ASR2.19-SB28-2-3-08D	ASR2.19-SB29-2-3-08D	ASR2.19-SB30-4-5-08D	ASR2.19-SB31-5-6-08D	ASR2.19-SB32-5-6-08D	ASR2.19-SB32D-5-6-08D	ASR2.19-SB33-1-2-08D	ASR2.19-SB34-1-2-08D
Sample Date				12/13/08	12/13/08	12/13/08	12/13/08	12/13/08	12/13/08	12/13/08	12/13/08	12/10/08	12/10/08
Chemical Name													
Explosives (µg/kg)													
Perchlorate	5,500	NS	--	2.6 U	2.4 U	2.7 U	2.5 U	2.3 U	2.5 U	2.2 U	2.5 U	2.5 U	2.6 U
Total Metals (mg/kg)													
Antimony	3.1	NS	0.36	0.92 UJ	0.9 UJ	0.95 UJ	0.95 UJ	0.88 UJ	0.9 UJ	0.85 UJ	0.8 UJ	0.89 UJ	0.89 UJ
Arsenic	0.39	5.8	2.12	2.1	**17.4**	0.9	1.2	0.34 J	0.6 U	0.53 J	0.61	**8.5**	0.58 J
Copper	310	700	2.56	0.71 J	0.55 J	1.6 U	0.77 J	1.5 U	1.5 U	0.61 J	0.69 J	1.8	1.5 U
Lead	400	270	8.49	2.1	1.1	1.3	1.4	1.4	1.5	1.6	1.8	4.6	1.1
Zinc	2,300	1,200	6.59	5.9	6.3	2.4	3	3	3.1	**6.8**	5.4	**6.8**	3

Notes:

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Federal Remediation Branch Preliminary Soil remediation Goals (January 2010)

TABLE 4-2
Subsurface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**NC PSRG (January 2010)**	**Camp Lejeune Background SB 2X Mean**	ASR2.19-SB35	ASR2.19-SB36		ASR2.19-SB37	ASR2.19-SB38	ASR2.19-SB39	ASR2.19-SB40	ASR2.19-SB41	ASR2.19-SB42	ASR2.19-SB43
Sample ID				ASR2.19-SB35-2-3-08D	ASR2.19-SB36-2-3-08D	ASR2.19-SB36D-2-3-08D	ASR2.19-SB37-2-3-08D	ASR2.19-SB38-5-6-08D	ASR2.19-SB39-5-6-08D	ASR2.19-SB40-5-6-08D	ASR2.19-SB41-0-0.5-08D	ASR2.19-SB42-5-6-08D	ASR2.19-SB43-4-5-08D
Sample Date				12/10/08	12/10/08	12/10/08	12/10/08	12/10/08	12/10/08	12/10/08	12/13/08	12/13/08	12/13/08
Chemical Name													
Explosives (µg/kg)													
Perchlorate	5,500	NS	--	2.5 U	2.3 U	2.3 U	2.5 U	2.5 U	2.2 U	2.2 U	2.5 U	2.5 U	2.4 U
Total Metals (mg/kg)													
Antimony	3.1	NS	0.36	0.91 UJ	0.86 UJ	0.85 UJ	0.9 UJ	0.88 UJ	0.96 UJ	0.82 UJ	0.88 UJ	0.87 UJ	0.94 UJ
Arsenic	0.39	5.8	2.12	0.48 J	0.5	0.88	0.73	0.36 J	0.75	0.97	0.21 J	0.24 J	0.84
Copper	310	700	2.56	1.5 U	1.4 U	1.4 U	1.5 U	1.5 U	1.6 U	0.75 J	1.5 U	1.5 U	0.7 J
Lead	400	270	8.49	1.2	1.5	1.3	1.4	1.1	1.6	2.1	1.2	0.82	3.2
Zinc	2,300	1,200	6.59	1.9	2.1	2.1	1.5	1.8	1.5	3	1.2 U	1.2 U	2.5

Notes:

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NC PRSG - North Carolina Department of Environment and Natural Resources

Federal Remediation Branch Preliminary Soil remediation Goals (January 2010)

TABLE 4-2
Subsurface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**NC PSRG (January 2010)**	**Camp Lejeune Background SB 2X Mean**	ASR2.19-SB44	ASR2.19-SB45	ASR2.19-SB49	ASR2.19-SB50	ASR2.19-SB51	ASR2.19-SB52	ASR2.19-SB57	ASR2.19-SB58		ASR2.19-SB59
Sample ID				ASR2.19-SB44-2-3-08D	ASR2.19-SB45-5-6-08C	ASR2.19-SB49-5-6-08D	ASR2.19-SB50-5-6-08D	ASR2.19-SB51-5-6-08D	ASR2.19-SB52-5-6-08C	ASR2.19-SB57-3-4-08D	ASR2.19-SB58-5-6-08D	ASR2.19-SB58D-5-6-08D	ASR2.19-SB59-5-6-08D
Sample Date				12/13/08	09/10/08	12/13/08	12/13/08	12/13/08	09/10/08	12/13/08	12/13/08	12/13/08	12/13/08
Chemical Name													
Explosives (µg/kg)													
Perchlorate	5,500	NS	--	2.3 U	NA	2.3 U	2.1 U	2.1 U	NA	2.5 U	2.4 U	2.4 U	2.4 U
Total Metals (mg/kg)													
Antimony	3.1	NS	0.36	0.86 UJ	0.81 UJ	0.87 UJ	0.8 UJ	0.79 UJ	0.87 UJ	**10.4 J**	0.94 UJ	0.88 UJ	0.85 UJ
Arsenic	0.39	5.8	2.12	1.1	0.57	1.1	0.4 J	0.72	**4.1**	0.29 J	0.86	0.55 J	0.24 J
Copper	310	700	2.56	0.97 J	1.4 U	2.4	0.51 J	0.36 J	0.36 J	2.5	1.7 J	**9.9 J**	0.37 J
Lead	400	270	8.49	3.5	1	**11.8**	2.2	1.1	1.4	4.1	4	3.9	1.7
Zinc	2,300	1,200	6.59	3.8	1.1 UJ	**12.5**	1.9	1.2	2.1 J	2.9	1.9	2.2	1.1 J

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Bold text indicates exceedance of Camp Lejeune Background criteria

NC PRSG - North Carolina Department of Environment and Natural Resources

Federal Remediation Branch Preliminary Soil remediation Goals (January 2010)

TABLE 4-2
Subsurface Soil Exceedance Results
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Station ID	**RSLs Residential Soil Adjusted**	**NC PSRG (January 2010)**	**Camp Lejeune Background SB 2X Mean**	ASR2.19-SB60	
Sample ID				ASR2.19-SB60-5-6-08C	ASR2.19-SB60D-5-6-08C
Sample Date				09/10/08	09/10/08
Chemical Name					
Explosives (µg/kg)					
Perchlorate	5,500	NS	--	NA	NA
Total Metals (mg/kg)					
Antimony	3.1	NS	0.36	0.83 UJ	0.83 UJ
Arsenic	0.39	5.8	2.12	0.31 J	0.42 J
Copper	310	700	2.56	0.66 J	0.73 J
Lead	400	270	8.49	1.8	1.8
Zinc	2,300	1,200	6.59	2.5 J	3.3 J

Notes:

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

NA - Not analyzed

NS - No Standard

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UJ - Analyte not detected, quantitation limit may be inaccurate

Shading indicates exceedance of Residential RSLs

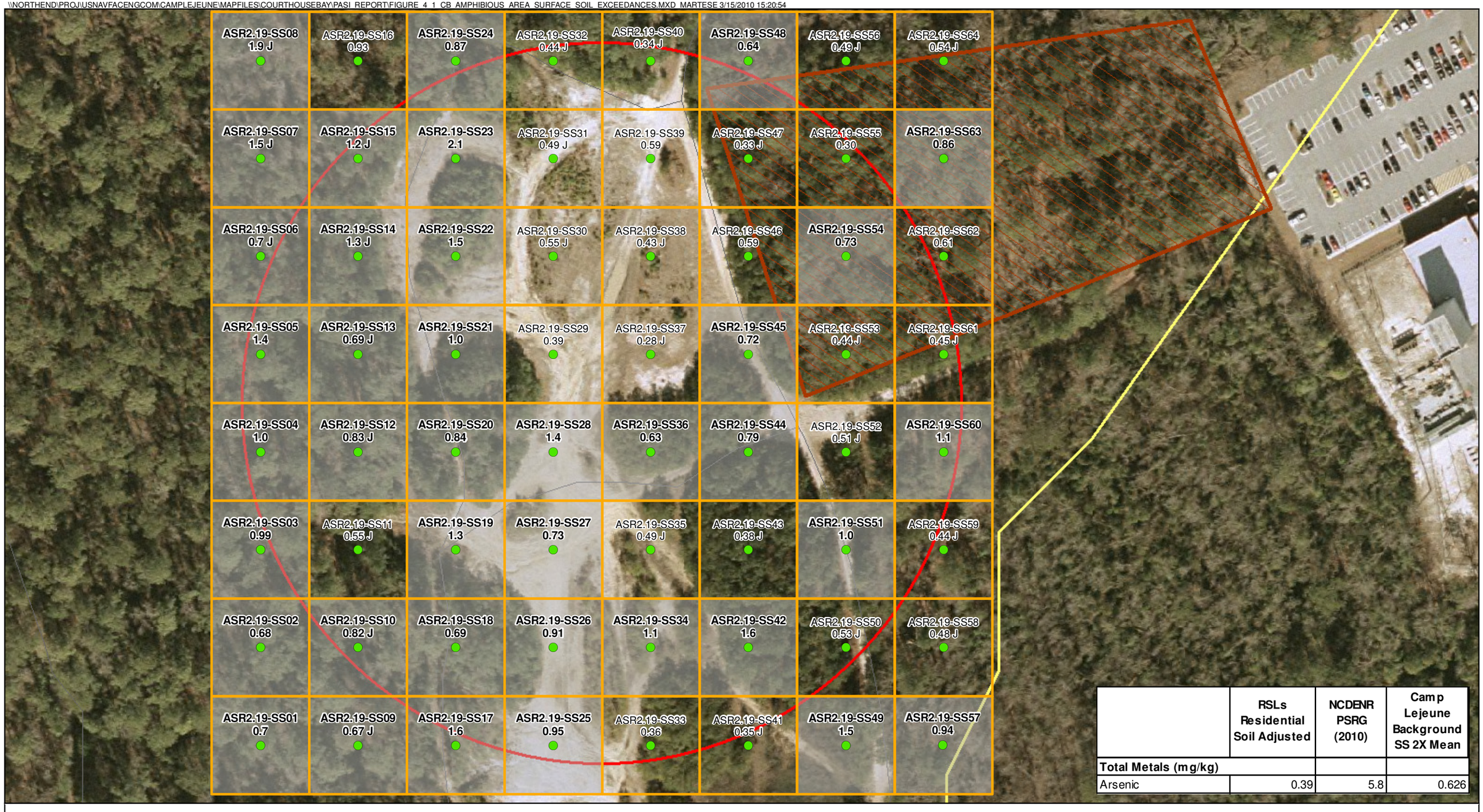
Bold box indicates exceedance of NC PSRG's criteria

Bold text indicates exceedance of Camp Lejeune Background criteria

NC PRSG - North Carolina Department of Environment and Natural Resources

Federal Remediation Branch Preliminary Soil remediation Goals (January 2010)

\\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\COURTHOUSEBAY\PASI_REPORT\FIGURE_4_1_CB_AMPHIBIOUS_AREA_SURFACE_SOIL_EXCEEDANCES.MXD MARTESE 3/15/2010 15:20:54



	RSLs Residential Soil Adjusted	NCDENR PSRG (2010)	Camp Lejeune Background SS 2X Mean
Total Metals (mg/kg)			
Arsenic	0.39	5.8	0.626

Legend
- Surface Soil Sample
- Parking Lot (completed January 2009)
- Former 1000-inch Small Arms Range
- Courthouse Bay Amphibious Area

Notes:
- Value beneath sample ID represents arsenic concentration (mg/kg)
- J Analyte present, value may or may not be accurate or precise
- **Bold text and shading indicates exceedance of Camp Lejeune Background Surface Soil 2 x Mean Average and EPA Residential RSL**

N

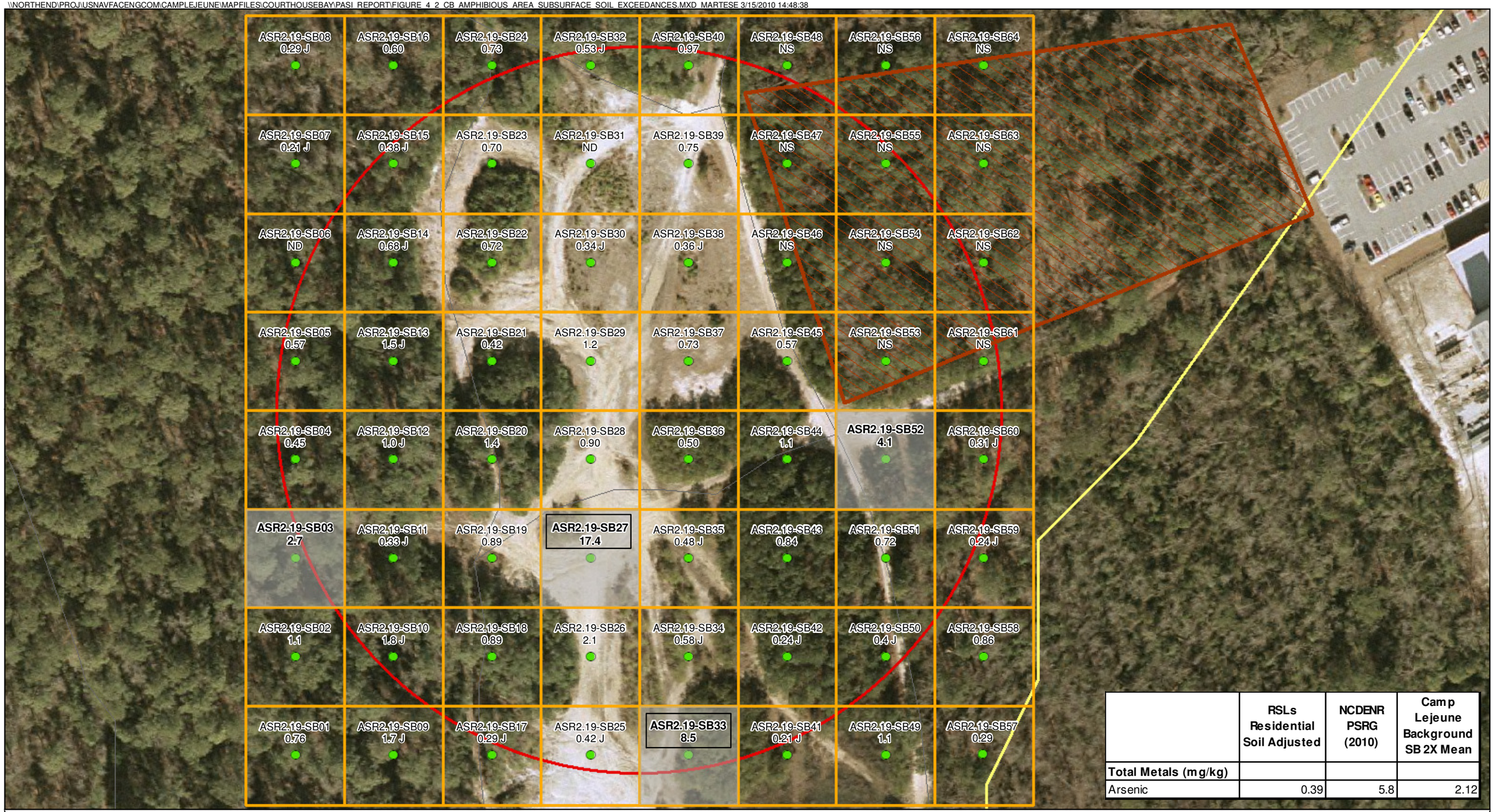
0 50 100 200 Feet

1 inch equals 100 feet

Figure 4-1
Surface Soil Exceedances
PA/SI Report for the Former 1,000-Inch Range (Amphibious Base Area) - UXO-15
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\COURTHOUSEBAY\PASI_REPORT\FIGURE_4_2_CB_AMPHIBIOUS_AREA_SUBSURFACE_SOIL_EXCEEDANCES.MXD MARTESE 3/15/2010 14:48:38



	RSLs Residential Soil Adjusted	NCDENR PSRG (2010)	Camp Lejeune Background SB 2X Mean
Total Metals (mg/kg)			
Arsenic	0.39	5.8	2.12

Legend
- Subsurface Soil Sample
- Parking Lot (completed January 2009)
- Former 1000-inch Small Arms Range
- Courthouse Bay Amphibious Area

Notes:
- Value beneath sample ID represents arsenic concentration (mg/kg)
- J Analyte present, value may or may not be accurate or precise
- ND - Not Detected
- NS - Not Sampled
- **Bold box, bold text and shading indicates exceedance of NCDENR PSRG, Camp Lejeune Background Subsurface Soil 2 x Mean Average and EPA Residential SSL, respectively**

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 4-2
Subsurface Soil Exceedances
PA/SI Report for the Former 1,000-Inch Range (Amphibious Base Area) - UXO-15
MCB CamLej
North Carolina

CH2MHILL

SECTION 5

Human Health Risk Screening

The surface and subsurface soil analytical sample data discussed in Section 4 were evaluated to assess the potential for human health risks associated with exposure to site soil. The risk evaluation was performed in two phases. The first phase included a conservative preliminary human health risk screening using appropriate human health risk-based screening values and MCB CamLej background concentrations. If either surface soil or subsurface soil indicated the potential for unacceptable human health risks related to constituents associated with past site use (chemicals were present in soil that exceeded the screening values), that medium was carried forward to the second phase of the risk evaluation. The second phase of the risk evaluation was a complete baseline Human Health Risk Assessment (HHRA).

The data evaluated during both phases of the risk assessment are presented in **Appendix A** and the samples are identified on **Table 5-1**. These data include the surface and subsurface soil analytical data collected during September and December 2008. The soil samples were analyzed for perchlorate and select metals (antimony, arsenic, copper, lead, and zinc), the chemicals that are related to the historic use of the site for training exercises using small arms and pyrotechnics. The data included in the risk evaluation were all validated. The validated data were evaluated to determine the reliability of the data for use in the HHRA. A review of the data identified the following criteria for data usability:

- Estimated values flagged with a J, J+, or J- qualifier were treated as detected concentrations.
- For duplicate samples, the maximum concentration between the two samples was used as the sample concentration.

5.1 Human Health Conceptual Site Model

The human health conceptual site model (CSM) presents an overview of site conditions, potential contaminant migration pathways, and exposure pathways to potential receptors. **Figure 5-1** presents the CSM associated with soil exposure at the site. As shown on **Figure 3-1**, the initial potential source of contamination at the site was use of small arms during the 1940s (including M1 rifles and .30- and .45-caliber pistols). Based upon the ASR, the Former 1,000-inch Range most likely was used as a small arms range for live fire from 1945 to 1946.

Currently, the site is partially open space and wooded areas. The site is used by Amphibious Assault Vehicle Battalion (AAV Bn) as a proving ground and is part of the Joint College Training Area. There are no live fire ranges in the area presently. Potential current receptors include industrial workers (i.e., training personnel), maintenance workers, and trespassers/visitors (identified as trespassers throughout the rest of this section and associated tables) who may enter the site. The current receptors may come in contact with

surface soil and exposure routes may include incidental ingestion, dermal contact, and inhalation of particulates from the surface soil.

Potential future receptors include future residents and construction workers for surface soil and total soil if site use is changed in the future. Potential future receptors also include industrial workers, maintenance workers, and trespassers for total soil. It is assumed that the future receptors could be exposed to total soil (i.e., surface and subsurface soil combined) if future residential houses or industrial buildings or piping/underground utilities are constructed at the site and the soil is reworked, bringing the subsurface soil to the surface. Exposure routes for the surface soil and total soil are the same as those for current surface soil—incidental ingestion of the soil, dermal contact with the soil, and inhalation of particulate emissions from the soil.

5.2 Phase I—Human Health Risk Screening

A preliminary human health risk screening was performed for the Former 1,000-inch Range to determine the potential for human health risks associated with exposure to site soil. The results of the human health risk screening provide a preliminary indication of potential risks from exposure to site soil (i.e., concentrations in soil exceed screening levels) and are used to help determine whether the site requires further evaluation (e.g., a baseline risk assessment and additional data collection) or future unrestricted use (residential use) of the site is acceptable based on human health risks.

5.2.1 Methodology

The maximum detected constituent concentrations in surface soil and total soil were compared to USEPA RSL (USEPA, 2008) for residential soil, as well as MCB CamLej background soil data from the *Final Base Background Soil Study Report* (Baker, 2001). The metal soil concentrations were compared to 2x Base background concentration. RSLs, based on noncarcinogenic effects were divided by 10 to account for exposure to multiple constituents (i.e., adjusted to a hazard quotient [HQ] of 0.1, from the HQ of 1.0 used on the USEPA RSL table). RSLs based on carcinogenic endpoints were used as presented in the RSL table and are based on a carcinogenic risk of 1×10^{-6}. If the maximum concentration of a constituent exceeded the RSL and background concentration (if applicable), that constituent was identified as a chemical of potential concern (COPC).

Although construction workers, industrial workers, and other populations are potential receptors for soil in addition to residential receptors, the soil data were only screened against residential soil RSLs. Residential soil RSLs are more conservative (i.e., lower) than industrial soil RSLs and are therefore protective of all potential receptors (e.g., residents, industrial workers, construction workers, recreational users).

5.2.2 Preliminary Human Health Risk Screening Results

The human health risk-based screening (comparison to risk-based criteria and background levels) was performed for surface soil and total soil (combined surface and subsurface soil).

Surface Soil Risk Screening

Tables 2.1 and **2.2** in **Appendix B** present the risk-based screening evaluation for surface soil. As shown on the tables, arsenic was the only constituent detected that exceeded the screening criteria and was identified as a COPC. Arsenic was detected in all of the surface soil samples and the majority of the detected concentrations are greater than the residential risk-based screening value. A number of the surface soil samples also had arsenic concentrations greater than 2x Base background value. Perchlorate was the only chemical analyzed for that was not detected in any of the surface soil samples. The detection limit for perchlorate in the surface soil samples were below the residential soil RSL.

Combined Surface and Subsurface Soil Risk Screening

Tables 2.3 and **2.4** in **Appendix B** present the risk-based screening evaluation for total soil (combined surface and subsurface soil). As shown on the tables, antimony and arsenic exceeded the screening criteria and were selected as COPCs. Antimony was detected in three of the 117 soil samples, with one sample exceeding the risk-based screening criteria and two samples exceeding 2x Base background. Arsenic was detected in 115 of the 117 soil samples and the majority of the detected concentrations exceeded the risk-based screening criteria. A number of samples also had arsenic concentrations that exceeded 2x Base background value. Perchlorate was the only chemical analyzed for that was not detected in any of the soil samples. The detection limit for perchlorate in the surface soil samples were below the residential soil RSL.

5.3 Phase II—Human Health Risk Assessment

A baseline HHRA was performed for surface soil and combined surface and subsurface soil based on the Phase I human health-risk based screening.

Supplemental information used in this HHRA and the risk calculations are presented in **Appendix B** and include the *Risk Assessment Guidance for Superfund* (RAGS*), Volume 1, Human Health Evaluation Manual Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (RAGS Part D) (USEPA, 2001a) tables and additional supporting tables. Guidance documents used for preparing the risk assessment include *RAGS Part A* (USEPA, 1989), RAGS Part D (USEPA, 2001a), *RAGS Part E* (USEPA, 2004a), and USEPA Region IV *Supplemental Guidance to RAGS: Region IV Bulletins* (USEPA, 2000).

The primary objective of this HHRA was to assess the health risks associated with exposure to soil under current site land use conditions and potential future site use under conservatively protective land use assumptions. The risk assessment is comprised of the following components:

- **Identification of COPC**—Identification of the chemicals found onsite and selection of the COPCs. The COPCs are the focus of the subsequent evaluation in the risk assessment.
- **Exposure Assessment**—Identification of the potential pathways of human exposure, and estimation of the magnitude, frequency, and duration of these exposures.

- **Toxicity Assessment**—Compilation of the toxicity values used for developing numerical risk estimates for the COPCs.
- **Risk Characterization**—Integration of the results of the exposure and toxicity assessments to develop numerical estimates of health risks.
- **Uncertainty Assessment**—Identification and discussion of sources of uncertainty in the risk assessment.

5.3.1 Identification of COPCs

Section 4 summarizes the surface soil and subsurface soil analytical results that were quantitatively evaluated in the risk assessment. The full sets of data are included in **Appendix A**.

The soil COPC screening is presented in **Appendix B**, **Tables 2.1** through **2.4**. The screening methodology used to select the COPCs for quantitative evaluation in the HHRA was the same as the Phase I screening evaluation as described in Section 5.2.1. In addition, concentrations of chemicals in air emanating from contaminated soil by fugitive dust emissions were compared to the USEPA RSL residential air values (USEPA, 2008). RSLs that are based on noncarcinogenic effects were divided by 10 to account for exposure to multiple constituents. RSLs based on carcinogenic effects were used as presented in the RSL table. The ambient air concentrations were calculated following the USEPA's soil screening guidance (USEPA, 2002), as shown in **Tables 2.2** and **2.4** in **Appendix B**. If the maximum concentration exceeded the criteria, the constituent was selected as a COPC. **Table 5-5** identifies the constituents that were selected as COPCs for surface soil and total soil (surface and subsurface sol). Arsenic was retained as a COPC for surface soil. Antimony and arsenic were retained as COPCs for total soil for quantitative evaluation in the HHRA. No COPCs were retained for the soil to air pathway for surface or total soil.

5.3.2 Exposure Assessment

Exposure assessment is the estimation of the likelihood, magnitude, frequency, duration, and routes of exposure to a chemical. Exposure refers to the potential contact of an individual (or receptor) with a chemical. Exposure can occur when contaminants migrate from a source to an exposure point, or when a receptor comes into direct contact with contaminated media.

The three components of exposure assessment include the following:

- Characterization of exposure setting
- Identification of exposure pathways
- Quantification of exposure

Characterization of Exposure Setting

Descriptions and the history of MCB CamLej and the Former 1,000-inch Range are included in Sections 2.1 and 2.2, respectively, as well as in Section 5.1.

Identification of Exposure Pathways

An exposure pathway can be described as the physical course that a COPC takes from the point of release to a receptor.

The potential exposure pathways for site-related media are shown in the CSM (**Figure 5-1** and **Table 1** in **Appendix B**) and were discussed in Section 5.1. Potential receptors exposed to surface soil under the current scenario are industrial workers, maintenance workers, and trespassers that may enter the site. Current site use does not allow for exposure to subsurface soil in the vicinity of the area. Potential future exposures to total soil (combined surface and subsurface soils) are assumed to occur if future residential houses or industrial buildings or piping/underground utilities are constructed at the site and the soil is reworked, bringing the subsurface soil to the surface. Potential receptors exposed to total soil are assumed to be industrial site workers, maintenance workers, trespassers, future residents, and construction workers.

In summary, the receptors and exposure routes for quantitative evaluation include the following:

- Current/future industrial workers: incidental ingestion of and dermal contact with surface soil
- Current/future maintenance workers: incidental ingestion of and dermal contact with surface soil
- Current/future trespasser (adult and youth): incidental ingestion of and dermal contact with surface soil
- Future resident (adult and child): incidental ingestion of and dermal contact with surface soil and subsurface soil
- Future construction worker: incidental ingestion of and dermal contact with surface soil and subsurface soil
- Future industrial worker: incidental ingestion of and dermal contact with subsurface soil
- Future maintenance worker: incidental ingestion of and dermal contact with subsurface soil
- Future trespasser (adult and youth): incidental ingestion of and dermal contact with subsurface soil

No COPCs were retained for the inhalation of particulate emissions from air exposure pathway (**Tables 2.2** and **2.4** in **Appendix B**). Therefore, this pathway was not evaluated as a complete exposure pathway in this risk assessment.

Quantification of Exposure

Exposure is quantified by estimating the exposure point concentrations (EPCs) of COPCs in environmental media and COPC intake by the receptor.

Exposure Concentrations

The EPCs are estimated constituent concentrations that a receptor may contact and are specific to each exposure medium. The EPCs estimated for COPCs at the Former 1,000-inch Range were the measured concentrations in surface soil and total soil.

Tables 3.1.RME and **3.2.RME** in **Appendix B** list the EPCs for the surface soils and total soil, respectively. The 95 percent upper confidence limit (UCL) on the mean concentration was used as the reasonable maximum exposure (RME) EPC for each COPC identified in surface soil and total soil. The EPC was identified following the parametric (distributional) and nonparametric recommendations offered in ProUCL (Version 4.00.02) (USEPA, 2007). The recommended UCL from the ProUCL output was used as the EPC for soil if the UCL did not exceed the maximum detected concentration. If the UCL exceeded the maximum detected concentration, then the maximum detected concentration was used as the EPC.

Estimation of Chemical Intakes

The quantification of exposure is based on an estimate of the average daily intake, or the average amount of the chemical contaminant entering the receptor's body per day. Chemical intakes are generally expressed as follows:

$$ADI = \frac{C \times CR \times CF \times EF \times ED}{BW \times AT}$$

Where:

ADI = average daily intake (mg/kg per day)

C = chemical concentration (mg/kg)

CR = contact rate (milligrams per day)

CF = conversion factor (kg/mg)

EF = exposure frequency (days per year)

ED = exposure duration (years)

BW = body weight (kilograms)

AT = averaging time (days)

The intake equation requires exposure parameters that are specific to each exposure pathway. Many of the exposure parameters have default values, which were used for this assessment. These assumptions, based on estimates of body weights, media intake levels, and exposure frequencies and duration are provided in USEPA guidance. RME exposure parameters were compiled. Central tendency exposure (CTE) risks were not calculated because the RME risks for all scenarios were lower than the USEPA's noncarcinogenic hazard or carcinogenic risk target levels. **Tables 4.1** though **4.3** in **Appendix B** identify the exposure parameters and intake equations for each of the scenarios evaluated.

To estimate exposure via dermal contact with soil, an additional exposure parameter—the dermal absorption fraction—is needed. This parameter is used to estimate the amount of a constituent in soil that would be absorbed by the skin. The absorption fraction of 0.03 was

used for arsenic (USEPA, 2004a). The default value for metals (0.001) was used for antimony (USEPA, 2000).

5.3.3 Toxicity Assessment

Toxicity assessment defines the relationship between the magnitude of exposure and possible severity of adverse effects and weighs the quality of available toxicological evidence. Toxicity assessment generally consists of two steps—hazard identification and dose-response assessment.

Hazard identification is the process of determining the potential adverse effects from exposure to the constituent along with the type of health effect involved. Dose-response assessment is the process of quantitatively evaluating the toxicity information and characterizing the relationship between the dose of the constituent administered or received and the incidence of adverse health effects in the exposed population. Toxicity criteria (e.g., reference doses and slope factors) are derived from the dose-response relationship.

The USEPA recommends that a tiered approach be used to obtain the toxicity values, the reference doses (RfDs) and cancer slope factors (CSFs), used to calculate non-cancer and cancer risks, respectively (USEPA, 2003). The sources of toxicity values are as follows:

- The USEPA's Integrated Risk Information System (IRIS) database (USEPA, 2009b)
- The Provisional Peer Reviewed Toxicity Value (PPRTV) database maintained by the USEPA's National Center for Environmental Assessment (NCEA) and the Superfund Health Risk Technical Support Center (STSC)
- Other USEPA sources including NCEA, Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997), California Environmental Protection Agency (Cal EPA), and the World Health Organization.

The use of provisional toxicity values, such as those from the PPRTV database, increases the uncertainty of the quantitative risk estimate.

The USEPA-derived oral and inhalation chronic and subchronic RfDs, and associated uncertainty factors (UFs) and modifying factors (MFs), for the COPCs are listed in **Tables 5.1** and **5.2** in **Appendix B**. The USEPA-derived oral and inhalation CSFs are listed in **Tables 6.1** and **6.2** in **Appendix B**.

Dermal RfDs and CSFs were estimated from oral RfDs and CSFs using an oral to dermal adjustment factor. This factor is designed to convert the orally administered dose toxicity factors to dermally absorbed dose toxicity factors (USEPA, 2004a). The oral RfDs were converted to dermal RfDs by multiplying by the oral to dermal adjustment factor (gastrointestinal [GI] absorption factor) and the oral CSFs were converted to dermal CSFs by dividing by the GI absorption factor. If a chemical-specific GI absorption factor was not available or was greater than 50 percent, a GI absorption factor of 100 percent was assumed. The dermal RfDs are included in **Table 5.1** in **Appendix B**. The dermal CSFs are presented in **Table 6.1** in **Appendix B**.

5.3.4 Risk Characterization

Risk characterization combines the results of the previous elements of the risk assessment to evaluate the potential health risks associated with exposure to the COPCs. The risk characterization is then used as an integral component in remedial decision making and selection of potential remedies or actions, as necessary.

Noncarcinogenic and Carcinogenic Risk Estimation Methods

Potential human health risks are discussed independently for carcinogenic and noncarcinogenic constituents. Some constituents may produce both noncarcinogenic and carcinogenic effects, and were evaluated in both groups. The methodology used to estimate noncarcinogenic hazards and carcinogenic risks are described as follows.

Noncarcinogenic health risks are estimated by comparing the calculated intake to an RfD. The calculated intake divided by the RfD is equal to the HQ:

$$HQ = Intake / RfD$$

The intake and RfD represent the same exposure period (i.e., chronic or subchronic) and the same exposure route (i.e., oral intakes are divided by oral RfDs). An HQ that exceeds 1.0 (i.e., the intake exceeds the RfD) indicates that there is a potential for adverse health effects associated with exposure to that constituent.

To assess the potential for noncarcinogenic health effects posed by exposure to multiple constituents, a hazard index (HI) approach is used (USEPA, 1986). This approach assumes that noncarcinogenic hazards associated with exposure to more than one constituent are additive and the HQs for individual constituents are added together. Synergistic or antagonistic interactions between constituents are not considered. The HI may exceed 1.0 even if all of the individual HQs are less than 1.0. HIs are also added across exposure routes and media to estimate the total noncarcinogenic health effects to a receptor posed by exposure through multiple routes and media. An HI greater than 1.0 indicates that there is some potential for adverse noncarcinogenic health effects associated with exposure to the contaminants of concern, possibly warranting remedial action. However, if the HI is greater than 1.0, the HI is calculated for each target organ/effect, to determine if the HI for a specific target organ/effect is greater than 1.0. If the HI for each target organ/effect is not above 1.0, it can be assumed that there is no unacceptable noncarcinogenic hazard to the receptor.

The potential for carcinogenic effects due to exposure to site-related constituents is evaluated by estimating the excess lifetime carcinogenic risk (ELCR). The ELCR is the incremental increase in the probability of developing cancer during one's lifetime in addition to the background probability of developing cancer. For example, an individual exposed to a carcinogen with a calculated cancer risk of 2×10^{-6} indicates that the probability of the individual getting cancer increases by two in a million above background levels.

Carcinogenic risk is calculated by multiplying the intake by the CSF.

$$ELCR = Intake \times CSF$$

The combined risk from exposure to multiple constituents was evaluated by adding the risks from individual constituents. Risks were also added across the exposure routes and media if an individual would be exposed through multiple routes and to multiple media.

When a cumulative carcinogenic risk to an individual receptor under the assumed RME exposure conditions at the site exceeds 100 in a million (i.e., 10^{-4} excess carcinogenic risk), CERCLA generally requires remedial action to reduce risks at the site (USEPA, 1991). If the cumulative risk is less than 10^{-4}, action generally is not required, but may be warranted if a risk-based chemical-specific standard (e.g., maximum contaminant level [MCL]) is exceeded.

Risk Assessment Results

The results of the risk characterization are presented as follows by receptor. The risks are calculated in **Appendix B**, **Tables 7.1**.**RME** through **7.16**.**RME**. The risks are summarized in **Appendix B**, **Tables 9.1.RME** through **9.16.RME.** A summary of the RME results is also shown in **Table 5-3.** The CTE risks were not calculated because none of the RME hazards exceeded 1.0 and the RME carcinogenic risks did not exceed 10^{-4}.

Surface Soil

Current/Future Industrial Worker, Surface Soil (Table 9.1.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a current/future industrial worker.

The RME noncarcinogenic HI of 0.0035 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (5.7×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Current/Future Maintenance Worker, Surface Soil (Table 9.2.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a current/future maintenance worker.

The RME noncarcinogenic HI of 0.00074 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (1.2×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Current/Future Trespasser Adult, Surface Soil (Table 9.3.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a current/future adult trespasser.

The RME noncarcinogenic HI of 0.00069 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (1.1×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Current/Future Trespasser Youth, Surface Soil (Table 9.4.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a current/future youth trespasser.

The RME noncarcinogenic HI of 0.0011 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (6.9×10^{-8}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Future Adult Resident, Surface Soil (Table 9.5.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a future adult resident.

The RME noncarcinogenic HI of 0.0046 is lower than the USEPA's target HI of 1.0. Carcinogenic risks were not calculated for an adult resident but were calculated for a lifetime resident, following USEPA guidance.

Future Child Resident, Surface Soil (Table 9.6.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a future child resident.

The RME noncarcinogenic HI of 0.042 is lower than the USEPA's target HI of 1.0. Carcinogenic risks were not calculated for a child resident but were calculated for a lifetime resident, in accordance with USEPA guidance.

Future Lifetime Resident, Surface Soil (Table 9.7.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a future lifetime resident.

The RME carcinogenic risk of 2.3×10^{-6} is within the USEPA's target risk range of 10^{-6} to 10^{-4}.

Future Construction Worker, Surface Soil (Table 9.8.RME, Appendix B)

Exposure to surface soil via incidental ingestion and dermal contact was evaluated for a future construction worker.

The RME noncarcinogenic HI of 0.015 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (9.5×10^{-8}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Total Soil

Future Industrial Worker, Total Soil (Table 9.9.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future industrial worker.

The RME noncarcinogenic HI of 0.0087 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (8.6×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Future Maintenance Worker, Total Soil (Table 9.10.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future maintenance worker.

The RME noncarcinogenic HI of 0.0018 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (1.8×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Future Trespasser Adult, Total Soil (Table 9.11.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future adult trespasser.

The RME noncarcinogenic HI of 0.0017 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (1.5×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Future Trespasser Youth, Total Soil (Table 9.12.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future youth trespasser.

The RME noncarcinogenic HI of 0.0027 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (1.1×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

Future Adult Resident, Total Soil (Table 9.13.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future adult resident.

The RME noncarcinogenic HI of 0.012 is lower than the USEPA's target HI of 1.0. Carcinogenic risks were not calculated for an adult resident but were calculated for a lifetime resident, following USEPA guidance.

Future Child Resident, Total Soil (Table 9.14.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future child resident.

The RME noncarcinogenic HI of 0.11 is lower than the USEPA's target HI of 1.0. Carcinogenic risks were not calculated for a child resident but were calculated for a lifetime resident, following USEPA guidance.

Future Lifetime Resident, Total Soil (Table 9.15.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future lifetime resident.

The RME carcinogenic risk of 3.5×10^{-6} is within the USEPA's target risk range of 10^{-6} to 10^{-4}. Both antimony and arsenic exceeded an ELCR of 1×10^{-6}.

Future Construction Worker, Total Soil (Table 9.16.RME, Appendix B)

Exposure to total soil via incidental ingestion and dermal contact was evaluated for a future construction worker.

The RME noncarcinogenic HI of 0.038 is lower than the USEPA's target HI of 1.0. The RME carcinogenic risk (1.4×10^{-7}) is less than the USEPA's target risk range of 10^{-6} to 10^{-4}.

5.4 Uncertainty Assessment

The risk measures used in HHRAs are not fully probabilistic estimates of risk, but rather are conditional estimates, given that a set of assumptions about exposure and toxicity are realized. Thus, it is important to specify the assumptions and uncertainties inherent in the risk assessment to place the risk estimates in proper perspective (USEPA, 1989).

5.4.1 Uncertainty in COPC Selection

The general assumptions used in the COPC selection process were conservative to ensure that true COPCs were not eliminated from the quantitative risk assessment and that the highest possible risk was estimated. RSLs based on residential assumptions were used to select the COPCs for all of the scenarios, including non-residential scenarios.

5.4.2 Uncertainty Associated with Exposure Assessment

The exposure pathways evaluated at the Former 1,000-inch Range are hypothetical and do not currently exist. It was assumed that the area may be used for residential development in the future. Based on the nature of MCB CamLej and the Former 1,000-inch Range area, this is not a likely scenario. If future construction were to occur, clean fill would most likely be placed on the land surface.

The exposure factors used for the quantitation of exposure were conservative and reflect worst-case or upper-bound assumptions on the exposure. The reliability of the values chosen for the exposure factors also contributes substantially to the uncertainty of the resulting risk estimates. Because most of the exposure factors are worst-case or upper-bound assumptions, the resulting risks are worst-case and likely overestimate the actual risk.

Site-related contamination is expected to decrease with time due to naturally occurring attenuation processes (e.g., degradation due to weathering, volatilization, advection, dispersion, leaching due to infiltrating precipitation). The risk assessment assumed concentrations would remain constant throughout the exposure period. This assumption likely results in an overestimation of risk.

5.4.3 Uncertainty Associated with Toxicity Assessment

The uncertainty associated with CSFs is mostly associated with the low-dose extrapolation, where carcinogenicity at low doses is assumed to be a linear response. This is a conservative assumption, which introduces a high uncertainty into slope factors that are extrapolated from this area of the dose-response curve. The CSFs are based on the assumption that there is no threshold level for carcinogenicity; however, most of the experimental studies indicate existence of a threshold level. Therefore, CSFs developed by the USEPA represent upper-bound estimates. Carcinogenic risks generated in this assessment should be regarded as an upper- bound estimate on the potential carcinogenic risks, rather than an accurate representation of carcinogenic risk. The true carcinogenic risk is likely to be less than the predicted value (USEPA, 1989).

A large degree of uncertainty is associated with the oral-to-dermal adjustment factors (based on chemical-specific GI absorption factors) used to transform the oral RfDs and CSFs based on administered doses to dermal RfDs and CSFs based on absorbed doses. It is not known if the adjustment factor results in an underestimation or overestimation of the actual toxicity associated with dermal exposure.

5.5 Uncertainty in Risk Characterization

The uncertainties identified in each component of risk assessment ultimately contribute to uncertainty in risk characterization. The addition of risks and HIs across pathways and chemicals contributes to uncertainty based on the interaction of chemicals such as additivity, synergism, potentiation, and susceptibility of exposed receptors. The simple assumption of additivity used for this site may or may not be accurate and may over-estimate or underestimate risk; however, a better alternative is not available at this time.

5.6 Human Health Risk Summary

Human health risks posed by current site conditions were evaluated for current industrial workers, maintenance workers, and trespassers that could have contact with surface soil. Assuming that the site use may change in the future (i.e., construction of residential houses), risks were also evaluated for potential future exposures to total soil (surface and subsurface soil). The following receptors were evaluated at the site:

- Current/future industrial workers
- Current/future maintenance workers
- Current/future trespasser (adult and youth)
- Future adult and child residents
- Future construction workers

Table 5-3 and **Tables 9.1.RME** through **9.16.RME** in **Appendix B** summarize the RME cancer risks and hazard indices.

Evaluation of the surface soil and total soil (surface and subsurface soil) suggests that RME noncarcinogenic hazards and cancer risks for all receptors are within or below USEPA target risk levels. Consequently, no unacceptable risks to human receptors are expected at the Courthouse Bay Amphibious Area site.

TABLE 5-1
Summary of Data Quantitatively Used in Risk Screening
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Medium	Date of Sampling	Sample	Parameters
Surface Soil	12/10/08	ASR2.19-SS01-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS02-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS03-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS04-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS05-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS05D-0-1-08D*	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS06-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS07-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS08-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS09-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS10-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS11-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS12-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS13-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS14-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS15-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS16-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS17-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS17D-0-1-08D*	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS18-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS19-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS20-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS21-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS22-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS23-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS24-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS25-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS26-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS27-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS28-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS29-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS30-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS31-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS32-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS32D-0-1-08D*	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS33-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS34-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS35-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS36-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS36D-0-1-08D*	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS37-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS38-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS39-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS40-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS41-0-0.5-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS42-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS43-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS44-0-1-08D	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS45-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS46-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS47-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS48-0-1-08C	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS49-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS50-0-1-08D	Perchlorate, Total Metals

TABLE 5-1
Summary of Data Quantitatively Used in Risk Screening
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Medium	Date of Sampling	Sample	Parameters
	12/13/08	ASR2.19-SS51-0-1-08D	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS52-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS53-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS54-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS55-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS56-0-1-08C	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS57-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS58-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS58D-0-1-08D*	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS59-0-1-08D	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS60-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS60D-0-1-08C*	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS61-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS62-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS63-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS64-0-1-08C	Perchlorate, Total Metals
Combined Surface and Subsurface Soil	12/10/08	ASR2.19-SS01-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS02-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS03-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS04-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS05-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS05D-0-1-08D*	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS06-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS07-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS08-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS09-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS10-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS11-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS12-0-1-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SS13-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS14-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS15-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS16-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS17-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS17D-0-1-08D*	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS18-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS19-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS20-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS21-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS22-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS23-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS24-0-1-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SS25-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS26-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS27-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS28-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS29-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS30-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS31-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS32-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS32D-0-1-08D*	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS33-0-1-08D	Perchlorate, Total Metals

TABLE 5-1
Summary of Data Quantitatively Used in Risk Screening
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Medium	Date of Sampling	Sample	Parameters
Combined Surface and Subsurface Soil (cont.)	12/10/08	ASR2.19-SS34-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS35-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS36-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS36D-0-1-08D*	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS37-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS38-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS39-0-1-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SS40-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS41-0-0.5-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS42-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS43-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS44-0-1-08D	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS45-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS46-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS47-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS48-0-1-08C	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS49-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS50-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS51-0-1-08D	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS52-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS53-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS54-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS55-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS56-0-1-08C	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS57-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS58-0-1-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS58D-0-1-08D*	Perchlorate, Total Metals
	12/13/08	ASR2.19-SS59-0-1-08D	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS60-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS60D-0-1-08C*	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS61-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS62-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS63-0-1-08C	Perchlorate, Total Metals
	09/10/08	ASR2.19-SS64-0-1-08C	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB01-5-6-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB02-5-6-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB03-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB04-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB05-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB05D-5-6-08D*	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB06-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB07-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB08-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB09-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB10-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB11-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB12-5-6-08D	Perchlorate, Total Metals
	12/11/08	ASR2.19-SB13-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB14-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB15-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB16-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB17-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB17D-5-6-08D*	Perchlorate, Total Metals

TABLE 5-1
Summary of Data Quantitatively Used in Risk Screening
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Medium	Date of Sampling	Sample	Parameters
Combined Surface and Subsurface Soil (cont.)	12/12/08	ASR2.19-SB18-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB19-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB20-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB21-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB22-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB23-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB24-5-6-08D	Perchlorate, Total Metals
	12/12/08	ASR2.19-SB25-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB26-2-3-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB27-2-3-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB28-2-3-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB29-2-3-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB30-4-5-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB31-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB32-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB32D-5-6-08D*	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB33-1-2-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB34-1-2-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB35-2-3-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB36-2-3-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB36D-2-3-08D*	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB37-2-3-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB38-5-6-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB39-5-6-08D	Perchlorate, Total Metals
	12/10/08	ASR2.19-SB40-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB41-0-0.5-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB42-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB43-4-5-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB44-2-3-08D	Perchlorate, Total Metals
	9/10/08	ASR2.19-SB45-5-6-08C	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB49-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB50-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB51-5-6-08D	Perchlorate, Total Metals
	9/10/08	ASR2.19-SB52-5-6-08C	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB57-3-4-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB58-5-6-08D	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB58D-5-6-08D*	Perchlorate, Total Metals
	12/13/08	ASR2.19-SB59-5-6-08D	Perchlorate, Total Metals
	9/10/08	ASR2.19-SB60-5-6-08C	Perchlorate, Total Metals
	9/10/08	ASR2.19-SB60D-5-6-08C*	Perchlorate, Total Metals

*Duplicate sample

TABLE 5-3
Summary of RME Cancer Risks and Hazard Indices
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

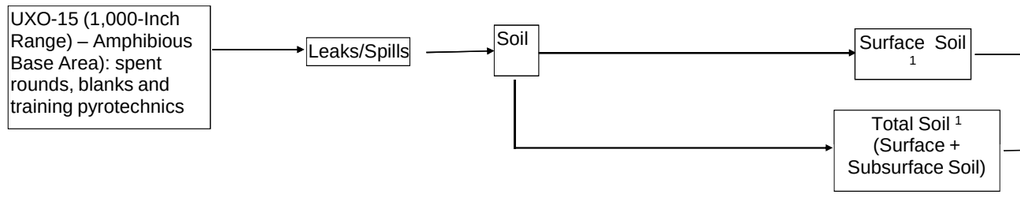
Receptor	Media	Exposure Route	Cancer Risk	COPCs with Cancer Risks >10^{-4}	COPCs with Cancer Risks >10^{-5} and <10^{-4}	COPCs with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	COPCs with HI > 1
Current/Future Indutrial Worker	Surface Soil	Ingestion	4.7E-07				0.0030	
		Dermal Contact	9.4E-08				0.00058	
		Total	**5.7E-07**				**0.0035**	
Current/Future Maintenance Worker	Surface Soil	Ingestion	9.9E-08				0.00061	
		Dermal Contact	2.0E-08				0.00012	
		Total	**1.2E-07**				**0.00074**	
Current/Future Adult Trespasser/Visitor	Surface Soil	Ingestion	9.5E-08				0.00061	
		Dermal Contact	1.1E-08				0.000073	
		Total	**1.1E-07**				**0.00069**	
Current/Future Youth Trespasser/Visitor	Surface Soil	Ingestion	6.1E-08				0.0010	
		Dermal Contact	7.9E-09				0.00012	
		Total	**6.9E-08**				**0.0011**	
Future Resident Adult	Surface Soil	Ingestion	NA				0.0041	
		Dermal Contact	NA				0.00049	
		Total	**NA**				**0.0046**	
Future Resident Child	Surface Soil	Ingestion	NA				0.039	
		Dermal Contact	NA				0.0032	
		Total	**NA**				**0.042**	
Future Resident Child/Adult	Surface Soil	Ingestion	2.1E-06			Arsenic	NA	
		Dermal Contact	2.0E-07				NA	
		Total	**2.3E-06**			**Arsenic**	**NA**	
Future Construction Worker	Surface Soil	Ingestion	9.1E-08				0.014	
		Dermal Contact	3.8E-09				0.00058	
		Total	**9.5E-08**				**0.015**	
Future Industrial Worker	Total Soil	Ingestion	7.2E-07				0.0076	
		Dermal Contact	1.4E-07				0.0010	
		Total	**8.6E-07**				**0.0087**	
Future Maintenance Worker	Total Soil	Ingestion	1.5E-07				0.0016	
		Dermal Contact	3.0E-08				0.00021	
		Total	**1.8E-07**				**0.0018**	
Future Adult Trespasser/Visitor	Total Soil	Ingestion	1.4E-07				0.0015	
		Dermal Contact	1.7E-08				0.00013	
		Total	**1.5E-07**				**0.0017**	

TABLE 5-3
Summary of RME Cancer Risks and Hazard Indices
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Receptor	Media	Exposure Route	Cancer Risk	COPCs with Cancer Risks >10^{-4}	COPCs with Cancer Risks >10^{-5} and <10^{-4}	COPCs with Cancer Risks >10^{-6} and <10^{-5}	Hazard Index	COPCs with HI > 1
Future Youth Trespasser/Visitor	Total Soil	Ingestion	9.3E-08				0.0025	
		Dermal Contact	1.2E-08				0.00022	
		Total	**1.1E-07**				**0.0027**	
Future Resident Adult	Total Soil	Ingestion	NA				0.011	
		Dermal Contact	NA				0.00087	
		Total	**NA**				**0.012**	
Future Resident Child	Total Soil	Ingestion	NA				0.10	
		Dermal Contact	NA				0.0057	
		Total	**NA**				**0.11**	
Future Resident Child/Adult	Total Soil	Ingestion	3.2E-06			Antimony, Arsenic	NA	
		Dermal Contact	3.1E-07				NA	
		Total	**3.5E-06**			**Antimony, Arsenic**	**NA**	
Future Construction Worker	Total Soil	Ingestion	1.4E-07				0.037	
		Dermal Contact	5.7E-09				0.0010	
		Total	**1.4E-07**				**0.038**	

NA - not applicable

FIgure 5-1
Conceptual Site Model for HHRA
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina



	Potential Human Receptors						
	Future			Current/Future			
Exposure Route	Residential Adult	Residential Child	Construction Worker	Industrial Worker	Maintenance Worker	Trespasser/Visitor Adult	Trespasser/Visitor Youth
Ingestion	X	X	X	X	X	X	X
Dermal Contact	X	X	X	X	X	X	X
Inhalation	X	X	X	X	X	X	X
Ingestion	X	X	X	X[2]	X[2]	X[2]	X[2]
Dermal Contact	X	X	X	X[2]	X[2]	X[2]	X[2]
Inhalation	X	X	X	X[2]	X[2]	X[2]	X[2]

[1] Only screening level evaluation for surface soil and subsurface soil
[2] For industrial worker, maintenance worker, and tresspasser/visitor, only future exposure to total soil.
X - Potentially complete exposure pathways

SECTION 6

Ecological Risk Screening

6.1 Environmental Receptors

No aquatic features are located onsite; however, a small pond, which appears a result of the recent parking lot construction activities, is located immediately south of the site. Sheet flow from a small percentage of the south end of the site potentially flows to this pond during heavy rain events, although a defined drainage feature was not noted during site visits by CH2M HILL and AGVIQ personnel. Wetland areas are located approximately 0.25 mile southeast of the site, bordering an unnamed creek that flows to Courthouse Bay. The creek and wetlands are not expected to be affected by site activities. Potential receptors at the site may include plants, invertebrates, mammals, reptiles, and birds.

6.2 Screening Methodology

Analytical results for surface soil collected in September and December 2008 were screened against ecological screening values (ESVs) intended to be protective of ecological receptors. Following data validation, the data were evaluated to determine the reliability of the data for use in the quantitative risk assessment. The maximum concentration was used in the screening to derive an HQ. An HQ over 1.0 suggests the potential for risk. The ESVs were identified from the following sources:

- *Region 4 Recommended Ecological Screening Values* (http://www.epa.gov/region04/waste/ots/ecolbul.htm) (USEPA, 2001b)
- *Ecological Soil Screening Levels* (http://www.epa.gov/ecotox/ecossl/) (USEPA, 2009a)
- *Guidelines for Performing Screening Level Ecological Risk Assessment within North Carolina* (http://*www.wastenotnc.org/SFHOME/SLERA.doc*) (NCDENR, 2003)

For soil, the USEPA Ecological Soil Screening Levels (EcoSSL) were preferentially selected over Region 4 or NCDENR values. When no EcoSSL was available for a chemical, the lower of the Region 4 and NCDENR value was selected.

The results of the ecological risk screening are summarized in the following section. Additional discussion is provided for detected chemicals with maximum concentrations in excess of screening values. The NCDENR Checklist for Ecological Assessments/ Sampling is included as **Appendix C**.

6.3 Surface Soil Ecological Risk Screening Results

Surface soil was collected from 64 locations. Antimony and lead had maximum concentrations in excess of the available EcoSSLs (**Table 6-1**). Due to the low frequencies of exceedance, low magnitudes of exceedance, and similarities to background concentrations, antimony and lead are not likely to cause unacceptable risk to ecological receptors.

Antimony was detected and exceeded the ESV in only two of 64 samples (0.46 mg/kg and 0.39 mg/kg), resulting in HQs of less than 2.0. The maximum concentration was approximately equal to 2x Base background (0.45 mg/kg), and within the range of concentrations detected in background (Baker, 2001).

While lead was detected in all 64 samples, only the samples collected from Grid 8 (29.6 mg/kg), Grid 12 (12.1 mg/kg), and Grid 49 (21.5 mg/kg) exceeded the EcoSSL of 11 mg/kg. In addition, the average lead concentration across the site (5.4 mg/kg) was below the EcoSSL and equal to the mean background concentration (5.4 mg/kg) (Baker, 2001). All concentrations of lead onsite were within the range of the concentrations detected in background.

6.4 Conclusion

Based on the review of surface soil analytical results and the ecological risk evaluations, no unacceptable risks exist for ecological receptors.

TABLE 6-1
Summary of Ecological Surface Soil Screening
1,000-Inch Range (Amphibious Base Area) – UXO-15
Preliminary Assessment/Site Inspection
MCB CamLej, North Carolina

Chemical	Maximum Concentration[a]	Location	Average[b]	Units	Detection Ratio	Camp Lejeune Background SS 2X Mean	Ecological Screening Value	Hazard Quotient
Perchlorate	0.003 U	NA	0.001	MG/KG	0/64	NA	NA	NA
Antimony	0.46 J	ASR2.19-SS49	0.435	MG/KG	2/64	0.447	0.27	**1.7**
Arsenic	2.1	ASR2.19-SS23	0.818	MG/KG	64/64	0.626	18	0.1
Copper	13.9 J	ASR2.19-SS60	1.407	MG/KG	57/64	4.83	28	0.5
Lead	29.6	ASR2.19-SS08	5.391	MG/KG	64/64	12.3	11	**2.7**
Zinc	40.1	ASR2.19-SS40	5.327	MG/KG	64/64	10.8	46	0.9

NA - Not available
U - The material was analyed for, but not detected
J - The material was detected at the concentrations level below the detection limit.
a - One half of the detection limit is reported if not detected
b - Average concentrations calculated using one half of the detection limits when applicable
Bold - Concentration exceeded ecological screening value
mg/kg - milligram per kilogram

SECTION 7

Conclusions and Recommendations

This section presents the conclusions reached based upon the PA/SI activities conducted at the Former 1,000-inch Range.

7.1 Conclusions

Arsenic and antimony were the only metals that were detected in surface and subsurface soil samples at concentrations exceeding more than two screening criteria levels. Arsenic was detected at concentrations exceeding the residential RSL (0.39 mg/kg) and 2x Base background (0.626 mg/kg) in surface soil collected from 38 of 64 sample grids and at concentrations exceeding the residential RSL (0.39 mg/kg) and 2x Base background (2.12 mg/kg) in subsurface soil collected from 4 of 53 sample grids., Arsenic detections were greater than the PSRG of 5.8 mg/kg at two locations.

Antimony was detected at a concentration exceeding 2x Base background criteria (0.36 mg/kg) and residential RSL (3.1 mg/kg) in one of the 53 subsurface soil samples at an estimated concentration of 10.4 mg/kg.

Based on the widespread distribution of arsenic and absence of lead concentrations exceeding 2x Base background, it is likely that the arsenic concentrations are naturally occurring or from anthropogenic sources and are not related to the Former 1,000-inch Range.

A baseline HHRA was performed to assess the health risks associated with exposure to soil under current site land use conditions and potential future site use under conservatively protective land use assumptions. Potential receptors exposure evaluations for RME noncarcinogenic and carcinogenic risk did not exceed the USEPA's target risk range of 10^{-6} to 10^{-4}, and the noncarcinogenic hazard HI did not exceed the USEPA's target HI of 1.0. Therefore, based on the human health risk evaluations for surface soil and subsurface soil, no unacceptable risks exist for current or future human health exposure.

Analytical results for surface soil were screened against ESVs intended to be protective of ecological receptors. Antimony and lead had maximum concentrations in excess of the available EcoSSLs. However, due to the low frequencies of exceedance, low magnitudes of exceedance, and similarities to background concentrations, antimony and lead are not likely to cause unacceptable risk to ecological receptors.

7.2 Recommendations

Based on the evaluation of the historical site information, field sampling activities, laboratory analytical results, as well as the finding of no unacceptable human health and ecologic risks, no further action is recommended for the Former 1,000-inch Range.

SECTION 8

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Appendix A
Analytical Results and Chain-of-Custody Forms

Appendix A is provided electronically on the attached CD-ROM.

Appendix B
Human Health Risk Assessment Information

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	Surface Soil	Industrial Worker	Adult	Ingestion	On-site	Quant	Current/future industrial workers could contact surface soil while performing activities at the site.
						Dermal Absorption	On-site	Quant	Current/future industrial workers could contact surface soil while performing activities at the site.
				Maintenance Worker	Adult	Ingestion	On-site	Quant	Current/future maintenance workers could contact surface soil while performing activities at the site.
						Dermal Absorption	On-site	Quant	Current/future maintenance workers could contact surface soil while performing activities at the site.
				Trespasser/ Visitor	Adult	Ingestion	On-site	Quant	Access to site unlimited for people on base; trespasser/visitor could contact site surface soil.
						Dermal Absorption	On-site	Quant	Access to site unlimited for people on base; trespasser/visitor could contact site surface soil.
					Youth	Ingestion	On-site	Quant	Access to site unlimited for people on base; trespasser/visitor could contact site surface soil.
						Dermal Absorption	On-site	Quant	Access to site unlimited for people on base; trespasser/visitor could contact site surface soil.
		Air	Emissions from Surface Soil	Industrial Worker	Adult	Inhalation	On-site	Quant	Industrial workers may inhale dust from surface soil at the site.
				Maintenance Worker	Adult	Inhalation	On-site	Quant	Maintenance workers may inhale dust from surface soil at the site.
				Trespasser/ Visitor	Adult	Inhalation	On-site	Quant	Access to site unlimited for people on base; trespasser/visitor could inhale dust from soil.
					Youth	Inhalation	On-site	Quant	Access to site unlimited for people on base; trespasser/visitor could inhale dust from soil.
Future	Surface Soil	Surface Soil	Surface Soil	Future Residents	Adult	Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact surface soil.
						Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact surface soil.
					Child	Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact surface soil.
						Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact surface soil.
					Child/Adult	Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact surface soil.
						Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact surface soil.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future (con't)	Surface Soil	Surface Soil	Surface Soil	Construction Worker	Adult	Ingestion	On-site	Quant	Future construction workers could contact surface soil while performing activities at the site.
						Dermal Absorption	On-site	Quant	Future construction workers could contact surface soil while performing activities at the site.
			Emissions from Surface Soil	Future Residents	Adult	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale dust from surface soil.
					Child	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale dust from surface soil.
					Child/Adult	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale dust from surface soil.
				Construction Worker	Adult	Inhalation	On-site	Quant	Exposure to emissions from surface soil during future construction activities.
	Total Soil	Total Soil	Total Soil	Future Residents	Adult	Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact total soil.
						Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact total soil.
					Child	Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact total soil.
						Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact total soil.
					Child/Adult	Ingestion	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact total soil.
						Dermal Absorption	On-site	Quant	Although unlikely, if site used for future residential development, residents could contact total soil.
				Construction Worker	Adult	Ingestion	On-site	Quant	Future construction workers could contact total soil while performing activities at the site.
						Dermal Absorption	On-site	Quant	Future construction workers could contact total soil while performing activities at the site.
				Industrial Worker	Adult	Ingestion	On-site	Quant	Future industrial workers could contact total soil while performing activities at the site.
						Dermal Absorption	On-site	Quant	Future industrial workers could contact total soil while performing activities at the site.
				Maintenance Worker	Adult	Ingestion	On-site	Quant	Future maintenance workers could contact total soil while performing activities at the site.
						Dermal Absorption	On-site	Quant	Future maintenance workers could contact soil* while performing activities at the site.

TABLE 1
SELECTION OF EXPOSURE PATHWAYS
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Total Soil	Total Soil	Total Soil	Trespasser/ Visitor	Adult	Ingestion	On-site	Quant	Access to site unlimited for people on base, trespasser/visitor could contact site total soil.
						Dermal Absorption	On-site	Quant	Access to site unlimited for people on base, trespasser/visitor could contact site total soil.
					Youth	Ingestion	On-site	Quant	Access to site unlimited for people on base, trespasser/visitor could contact site total soil.
						Dermal Absorption	On-site	Quant	Access to site unlimited for people on base, trespasser/visitor could contact site total soil.
			Emissions from Total Soil	Future Residents	Adult	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale dust from total soil.
					Child	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale dust from total soil.
					Child/Adult	Inhalation	On-site	Quant	If site used for future residential development, residents could inhale dust from total soil.
				Construction Worker	Adult	Inhalation	On-site	Quant	Exposure to emissions from total soil during future construction activities.
				Industrial Worker	Adult	Inhalation	On-site	Quant	Industrial workers may inhale dust from total soil at the site.
				Maintenance Worker	Adult	Inhalation	On-site	Quant	Maintenance workers may inhale dust from total soil at the site.
				Trespasser	Adult	Inhalation	On-site	Quant	Access to site unlimited for people on base, trespasser/visitor could be exposed to dust in air from site total soil.
					Youth	Inhalation	On-site	Quant	Access to site unlimited for people on base, trespasser/visitor could be exposed to dust in air from site total soil.

Total soil is combined surface and subsurface soil.

TABLE 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Surface Soil	**Explosives**															
	14797-73-0	Perchlorate	ND	ND	mg/kg		0/64	0.0021 - 0.003	3.0E-03	NA	5.5E+00	nc	NA	NA	NO	BSL
	Total Metals															
	7440-36-0	Antimony	3.9E-01 J	4.6E-01 J	mg/kg	ASR2.19-SS49-0-1-08D	2/64	0.77 - 0.99	4.6E-01	4.5E-01	3.1E+00	nc	5.4E+00	SSL	NO	BSL
	7440-38-2	Arsenic	2.8E-01 J	2.1E+00	mg/kg	ASR2.19-SS23-0-1-08D	64/64	0.51 - 0.66	2.1E+00	6.3E-01	3.9E-01	ca*	5.2E+00	SSL	YES	ASL
	7440-50-8	Copper	2.8E-01 J	1.4E+01	mg/kg	ASR2.19-SS60-0-1-08C	57/64	1.3 - 1.6	1.4E+01	4.8E+00	3.1E+02	nc	7.0E+02	SSL	NO	BSL
	7439-92-1	Lead	1.2E+00	3.0E+01	mg/kg	ASR2.19-SS08-0-1-08D	64/64	0.15 - 0.2	3.0E+01	1.2E+01	4.0E+02	nc	2.7E+02	SSL	NO	BSL
	7440-66-6	Zinc	1.3E+00	4.0E+01	mg/kg	ASR2.19-SS40-0-1-08D	64/64	1 - 1.3	4.0E+01	1.1E+01	2.3E+03	nc	5.5E+02	SSL	NO	BSL

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are two times the arithmetic mean basewide background surface soil concentrations.
Background values are from *Final Base Background Soil Study Report, Marine Corps Base Camp Lejeune, North Carolina* , Baker Environmental, April 25, 2001.

[4] Regional Screening Levels for Contaminants at Superfund Sites, Residential Soil, September, 2008.
Noncancer SLs divided by 10 to adjust for exposure to multiple constituents

[5] Rationale Codes
Selection Reason:
Above Screening Level (ASL)
Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA
Deletion Reason:
No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Detection Limit Below Screening Level (DLBSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
ca = Carcinogenic
ca* = Carcinogenic, where: nc < 100 X ca
nc = Noncarcinogenic
SSL = North Carolina Soil Screening Levels (NCDENR, 2008)

TABLE 2.2

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Emissions from Surface Soil	**Total Metals**															
	7440-36-0	Antimony	2.9E-07 J	3.4E-07 J	ug/m^3	ASR2.19-SS49-0-1-08D	2/64	NA	3.4E-07	NA	NA		NO			NXT
	7440-38-2	Arsenic	2.1E-07 J	1.5E-06	ug/m^3	ASR2.19-SS23-0-1-08D	64/64	NA	1.5E-06	NA	5.7E-04	c*			NO	BSL
	7440-50-8	Copper	2.1E-07 J	1.0E-05	ug/m^3	ASR2.19-SS60-0-1-08C	57/64	NA	1.0E-05	NA	NA		NO			NXT
	7439-92-1	Lead	8.8E-07	2.2E-05	ug/m^3	ASR2.19-SS08-0-1-08D	64/64	NA	2.2E-05	NA	NA		NO			NXT
	7440-66-6	Zinc	9.6E-07	2.9E-05	ug/m^3	ASR2.19-SS40-0-1-08D	64/64	NA	2.9E-05	NA	NA		NO			NXT

[1] Minimum/Maximum calculated air concentrations. Air concentration (ug/m^3) = soil concentration (mg/kg) x (1/VF + 1/PEF) x 1000 ug/mg. VF used only for VOCs, and calculated on Table 2.2A. PEF = $1.36x10^9$ m^3/kg.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Regional Screening Levels for Contaminants at Superfund Sites, Residential Air September, 2008.

[5] Rationale Codes

Selection Reason:
- Above Screening Levels (ASL)
- Detection Limit Above Screening Levels (DLASL), not evaluated quantitatively, but discussed in uncertainty assessment

Deletion Reason:
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)
- Detection Limit Below Screening Level (DLBSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

ca = Carcinogenic

nc = Noncarcinogenic

ca* = Carcinogenic (where nc PRG<100 x ca PRG)

TABLE 2.3

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value		Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Total Soil*	**Explosives**															
	14797-73-0	Perchlorate	ND	ND	mg/kg		0/117	0.0021 - 0.003	3.0E-03	NA	5.5E+00	nc	NA	NA	NO	BSL
	Total Metals															
	7440-36-0	Antimony	3.9E-01 J	1.0E+01	mg/kg	ASR2.19-SB57-3-4-08D	3/117	0.77 - 0.99	1.0E+01	3.6E-01	3.1E+00	nc	5.4E+00	SSL	YES	ASL
	7440-38-2	Arsenic	2.1E-01 J	1.7E+01	mg/kg	ASR2.19-SB27-2-3-08D	115/117	0.51 - 0.66	1.7E+01	6.3E-01	3.9E-01	ca*	5.2E+00	SSL	YES	ASL
	7440-50-8	Copper	2.8E-01 J	1.4E+01 J	mg/kg	ASR2.19-SS60D-0-1-08C	95/117	1.3 - 1.6	1.4E+01	2.6E+00	3.1E+02	nc	7.0E+02	SSL	NO	BSL
	7439-92-1	Lead	8.2E-01 J	3.0E+01	mg/kg	ASR2.19-SS08-0-1-08D	117/117	0.15 - 0.2	3.0E+01	8.5E+00	4.0E+02	nc	2.7E+02	SSL	NO	BSL
	7440-66-6	Zinc	1.1E+00 J	4.0E+01	mg/kg	ASR2.19-SS40-0-1-08D	113/117	1 - 1.3	4.0E+01	6.6E+00	2.3E+03	nc	5.5E+02	SSL	NO	BSL

Total Soil* = combined surface and subsurface soil

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are the lower of two times the arithmetic mean basewide background surface soil or subsurface soil concentrations.
Background values are from *Final Base Background Soil Study Report, Marine Corps Base Camp Lejeune, North Carolina* , Baker Environmental, April 25, 2001.

[4] Regional Screening Levels for Contaminants at Superfund Sites, Residential Soil, September, 2008.
Noncancer SLs divided by 10 to adjust for exposure to multiple constituents

[5] Rationale Codes
Selection Reason:
Above Screening Level (ASL)
Detection Limit Above Screening Level (DLASL), not quantitatively evaluated in HHRA
Deletion Reason:
No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)
Detection Limit Below Screening Level (DLBSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
ca = Carcinogenic
ca* = Carcinogenic, where: nc < 100 X ca
nc = Noncarcinogenic
SSL = North Carolina Soil Screening Levels (NCDENR, 2008)

TABLE 2.4

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Air

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Emissions from Total Soil	**Total Metals**														
	7440-36-0	Antimony	2.9E-07 J	7.6E-06	ug/m^3	ASR2.19-SB57-3-4-08D	2/117	NA	7.6E-06	NA	NA	NO			NXT
	7440-38-2	Arsenic	1.5E-07 J	1.3E-05	ug/m^3	ASR2.19-SB27-2-3-08D	115/117	NA	1.3E-05	NA	5.7E-04 c*			NO	BSL
	7440-50-8	Copper	2.1E-07 J	1.0E-05 J	ug/m^3	ASR2.19-SS60D-0-1-08C	95/117	NA	1.0E-05	NA	NA			NO	NXT
	7439-92-1	Lead	6.0E-07 J	2.2E-05	ug/m^3	ASR2.19-SS08-0-1-08D	117/117	NA	2.2E-05	NA	NA			NO	NXT
	7440-66-6	Zinc	8.1E-07 J	2.9E-05	ug/m^3	ASR2.19-SS40-0-1-08D	113/117	NA	2.9E-05	NA	NA			NO	NXT

Total Soil* = combined surface and subsurface soil

[1] Minimum/Maximum calculated air concentrations. Air concentration (ug/m^3) = soil concentration (mg/kg) x (1/VF + 1/PEF) x 1000 ug/mg.
VF used only for VOCs.

[2] Maximum concentration is used for screening.

[3] Background values not available.

[4] Regional Screening Levels for Contaminants at Superfund Sites, Residential Air September, 2008.

[5] Rationale Codes

Selection Reason:
- Above Screening Levels (ASL)
- Detection Limit Above Screening Levels (DLASL), not evaluated quantitatively, but discussed in uncertainty assessment

Deletion Reason:
- No Toxicity Information (NTX)
- Essential Nutrient (NUT)
- Below Screening Level (BSL)
- Detection Limit Below Screening Level (DLBSL)

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

ca = Carcinogenic

nc = Noncarcinogenic

ca* = Carcinogenic (where nc PRG<100 x ca PRG)

TABLE 3.1.RME
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Medium: Surface Soil (0-1 ft)
Exposure Medium: Surface Soil (0 - 1 ft)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
UXO-15 Surface Soil (0-1 ft)	Arsenic	mg/Kg	8.2E-01	9.1E-01 G	2.1E+00	9.1E-01	mg/Kg	App. Gamma	3, 4

ProUCL, Version 4.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2007. ProUCL, Version 4.0. Prepared by Lockheed Martin Environmental Services).

Options: 95% Approximate Gamma (App. Gamma); 95% Kaplan-Meier (t) UCL (95% KM-t); 95% Kaplan-Meier Chebyshev (95% KM); 95% Kaplan-Meier BCA (95% KM-BCA) 95% Chebyshev (Mean, Sd) UCL (95% Cheb-m); 95% Student's-T test UCL (95% Stud-t); 99% Kaplan-Meier Chebyshev (99% KM); 95% Kaplan-Meier (Percentile Bootstrap) UCL (95% KM (Bootstrap)); 97.5% Kaplan-Meier Chebyshev (97.5% KM); 99% Chebyshev (Mean, Sd) UCL (99% Cheb-m); 95% Hall's Bootstrap UCL (95% Hall's); 95% H-UCL (95% H-UCL); Maximum Detected Value (Max)

(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) Max value used because 95% UCL greater than max.

G = Gamma
J = Estimated Value
MG/KG = milligrams per kilogram
N = Normal
NP = Non-Parametric
T = Log-Transformed

TABLE 3.2.RME
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil (0-10 ft)
Exposure Medium: Total Soil (0 - 10 ft)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
UXO-15 Total Soil* (0-10 ft)	Antimony	mg/Kg	5.5E-01	1.3E+00 NP	1.0E+01	1.3E+00	mg/Kg	97.5% KM	5
	Arsenic	mg/Kg	1.0E+00	1.4E+00 NP	1.7E+01	1.4E+00	mg/Kg	95% KM-BCA	5

Total Soil* = combined surface and subsurface soil

ProUCL, Version 4.0 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2007. ProUCL, Version 4.0. Prepared by Lockheed Martin Environmental Services).

Options: 95% Approximate Gamma (App. Gamma); 95% Kaplan-Meier (t) UCL (95% KM-t); 95% Kaplan-Meier Chebyshev (95% KM); 95% Kaplan-Meier BCA (95% KM-BCA) 95% Chebyshev (Mean, Sd) UCL (95% Cheb-m); 95% Student's-T test UCL (95% Stud-t); 99% Kaplan-Meier Chebyshev (99% KM); 95% Kaplan-Meier (Percentile Bootstrap) UCL (95% KM (Bootstrap)); 97.5% Kaplan-Meier Chebyshev (97.5% KM); 99% Chebyshev (Mean, Sd) UCL (99% Cheb-m); 95% Hall's Bootstrap UCL (95% Hall's); 95% H-UCL (95% H-UCL); Maximum Detected Value (Max)

(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) Max value used because 95% UCL greater than max.

G = Gamma
J = Estimated Value
MG/KG = milligrams per kilogram
N = Normal
NP = Non-Parametric

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Worker	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Maintenance Worker	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Youth	Surface Soil	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg	see Table 3.1.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	45	kg	EPA, 2000	
				AT-C	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	
				AT-N	Averaging Time (Cancer)	25,550	days	EPA, 1989	
Dermal	Industrial Worker	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
	Maintenance Worker	Adult	Surface Soil	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg	see Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser	Adult	Surface Soil	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg	see Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Youth	Surface Soil	CS	Chemical Concentration in Soil	see Table 3.1.RME	mg/kg	see Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	4,300	cm^2	EPA, 1997 (3)	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm^2-day	EPA, 2004, (4)	ED x ET x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	45	kg	EPA, 2000	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	

(1) Professional judgment assuming 1 day per week for 52 weeks per year.

(2) Professional judgment assuming adolescents from 7 to 16 years of age.

(3) SA is the total of the head, hands, forearms and lower legs for the 7 through 16 year olds.

(4) SSAF is the geometric mean weighted soil adherence to legs for Rugby from EPA, 2004, Exhibit 3-3.

(5) SSAF based on adherence factor for (Geometric Mean) utility workers - Exhibit 3-3 of RAGS Part E.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

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EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Carcinogenic
				IR-Sa	Ingestion Rate of Soil-adult	100	mg/day	EPA, 1991	Chronic Daily Intake (CDI) (mg/kg-day) =
				EDa	Exposure Duration adult	24	years	EPA, 1991	CS x IR-S x EF x CF x 1/AT
				BWa	Body Weight adult	70	kg	EPA, 1991	
				IR-Sc	Ingestion Rate of Soil-child	200	mg/day	EPA, 1991	
				EDc	Exposure Duration child	6	years	EPA, 1991	IR-S = (EDc * IR-Sc/ BWc) +
				BWc	Body Weight child	15	kg	EPA, 1991	(EDa * IR-Sa/BWa)
				IR-S	Ingestion Rate of Soil-adjusted	114.29	mg-year/kg-day	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Construction Worker	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	480	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	Carcinogenic CDI (mg/kg-day) =
				SAc	Skin Surface Area child	2,800	cm^2	EPA, 2004	CS x SA x DABS x CF3 x EF x 1/AT
				SSAFc	Soil to Skin Adherence Factor child	0.2	mg/cm^2-day	EPA, 2004	
				EDc	Exposure Duration child	6	years	EPA, 1991	SA =
				BWc	Body Weight child	15	kg	EPA, 1991	((EDc * SAc/BWc)*SSAFc) + ((EDa * SAa/BWa)*SSAFa)
				SAa	Skin Surface Area adult	5,700	cm^2	EPA, 2004	
				SSAFa	Soil to Skin Adherence Factor-adult	0.07	mg/cm^2-day	EPA, 2004	
				EDa	Exposure Duration adult	24	years	EPA, 1991	
				BWa	Body Weight adult	70	kg	EPA, 1991	
				SA	Skin Surface Area adjusted	361	cm^2-year/kg-day	---	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1	mg/kg	See Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/years	Prof. Judgment	
				ED	Exposure Duration	1	years	Prof. Judgment	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

(1) Professional judgment assuming 1 day per week for 52 weeks per year.

(2) Professional judgment assuming adolescents from 7 to 16 years of age.

(3) SA is the total of the head, hands, forearms and lower legs for the 7 through 16 year olds.

(4) SSAF is the geometric mean weighted soil adherence to legs for Rugby from EPA, 2004, Exhibit 3-3.

(5) SSAF based on adherence factor for (Geometric Mean) utility workers - Exhibit 3-3 of RAGS Part E.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

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EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Carcinogenic
				IR-Sa	Ingestion Rate of Soil-adult	100	mg/day	EPA, 1991	Chronic Daily Intake (CDI) (mg/kg-day) =
				EDa	Exposure Duration adult	24	years	EPA, 1991	CS x IR-S x EF x CF x 1/AT
				BWa	Body Weight adult	70	kg	EPA, 1991	
				IR-Sc	Ingestion Rate of Soil-child	200	mg/day	EPA, 1991	
				EDc	Exposure Duration child	6	years	EPA, 1991	IR-S = (EDc * IR-Sc/ BWc) +
				BWc	Body Weight child	15	kg	EPA, 1991	(EDa * IR-Sa/BWa)
				IR-S	Ingestion Rate of Soil-adjusted	114.29	mg-year/kg-day	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Construction Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	480	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	1	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Maintenance Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Trespasser	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Youth	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	45	kg	EPA, 2000	
				AT-C	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	
				AT-N	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	Carcinogenic CDI (mg/kg-day) =
				SAc	Skin Surface Area child	2,800	cm^2	EPA, 2004	CS x SA x DABS x CF3 x EF x 1/AT
				SSAFc	Soil to Skin Adherence Factor child	0.2	mg/cm^2-day	EPA, 2004	
				EDc	Exposure Duration child	6	years	EPA, 1991	SA =
				BWc	Body Weight child	15	kg	EPA, 1991	((EDc * SAc/BWc)*SSAFc) + ((EDa * SAa/BWa)*SSAFa)
				SAa	Skin Surface Area adult	5,700	cm^2	EPA, 2004	
				SSAFa	Soil to Skin Adherence Factor-adult	0.07	mg/cm^2-day	EPA, 2004	
				EDa	Exposure Duration adult	24	years	EPA, 1991	
				BWa	Body Weight adult	70	kg	EPA, 1991	
				SA	Skin Surface Area adjusted	361	cm^2-year/kg-day	---	
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/years	Prof. Judgment	
				ED	Exposure Duration	1	years	Prof. Judgment	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
	Industrial Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Maintenance Worker	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Medium: Total Soil
Exposure Medium: Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser	Adult	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	chem specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Youth	Total Soil	CS	Chemical Concentration in Soil	See Table 3.2	mg/kg	See Table 3.2	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	4,300	cm^2	EPA, 1997 (3)	CS x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm^2-day	EPA, 2004, (4)	ED x ET x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2004	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	45	kg	EPA, 2000	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	

(1) Professional judgment assuming 1 day per week for 52 weeks per year.

(2) Professional judgment assuming adolescents from 7 to 16 years of age.

(3) SA is the total of the head, hands, forearms and lower legs for the 7 through 16 year olds.

(4) SSAF is the geometric mean weighted soil adherence to legs for Rugby from EPA, 2004, Exhibit 3-3.

(5) SSAF based on adherence factor for (Geometric Mean) utility workers - Exhibit 3-3 of RAGS Part E.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2000: Supplemental Guidance to RAGS: Region 4 Bulletins, Human Health Risk Assessment Bulletins. www.epa.gov/region4/waste/oftecser/healtbul.htm.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Antimony	Chronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	blood	1000/1	IRIS	4/13/2009
	Subchronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	blood, whole body	1000	HEAST	07/31/1997
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3/1	IRIS	4/13/2009
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	7/1/1997

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment (FINAL).
Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%.
Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

(2) Adjusted Dermal RfD = RfD (oral) x Absorption Efficiency or ABS_{GI}

(3) For IRIS values, the date IRIS was searched.
For HEAST values, the date of HEAST.

TABLE 5.2
NON-CANCER TOXICITY DATA -- INHALATION
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (2) (MM/DD/YY)
Antimony	Subchronic/Chronic	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Chronic	3.0E-05	mg/m^3	8.6E-06	mg/kg-day	Skin, Vascular	NA	CalEPA (EPA RSL)	9/12/2008
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA

NA = Not Applicable

Cal/EPA = California Environmental Protection Agency

EPA RSL = Environmental Protection Agency (EPA) Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites (EPA, 2008)

(1) Adjusted Inhalation RfD = (Inhalation RfC) * (20/70)

(2) For CalEPA (EPA RSL), the date of RSL tables.

TABLE 6.1
CANCER TOXICITY DATA -- ORAL/DERMAL
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (2) (MM/DD/YY)
Antimony	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/13/2009

NA = Not available

IRIS = Integrated Risk Information System

(1) Refer to RAGS, Part E. July 2004.

(2) For IRIS values, provide the date IRIS was searched.

EPA Carcinogen Group:

A - Human carcinogen

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15
Camp Lejeune, Jacksonville, NC

Chemical of Potential Concern	Unit Risk	Units	Adjustment (1)	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date (2) (MM/DD/YY)
Antimony	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m3)^{-1}$	3500	1.5E+01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	4/13/2009

NA = Not Available
IRIS = Integrated Risk Information System

(1) Adjustment Factor applied to Unit Risk to calculate Inhalation Slope Factor = 70kg x 1/20m3/day x 1000ug/mg
(2) For IRIS values, provide the date IRIS was searched.

EPA Group:
A - Human carcinogen
B1 - Probable human carcinogen - indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as a human carcinogen
E - Evidence of noncarcinogenicity

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	3.2E-07	mg/kg/day	1.5E+00	1/mg/kg-day	4.7E-07	8.9E-07	mg/kg/day	3.0E-04	mg/kg/day	3.0E-03
			Exp. Route Total								4.7E-07					3.0E-03
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	6.3E-08	mg/kg/day	1.5E+00	1/mg/kg-day	9.4E-08	1.8E-07	mg/kg/day	3.0E-04	mg/kg/day	5.8E-04
			Exp. Route Total								9.4E-08					5.8E-04
		Exposure Point Total									5.7E-07					3.5E-03
	Exposure Medium Total										5.7E-07					3.5E-03
Soil Total											5.7E-07					3.5E-03
											Total of Receptor Risks Across All Media	5.7E-07		Total of Receptor Hazards Across All Media		3.5E-03

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	6.6E-08	mg/kg/day	1.5E+00	1/mg/kg-day	9.9E-08	1.8E-07	mg/kg/day	3.0E-04	mg/kg/day	6.1E-04
			Exp. Route Total								9.9E-08					6.1E-04
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	1.3E-08	mg/kg/day	1.5E+00	1/mg/kg-day	2.0E-08	3.6E-08	mg/kg/day	3.0E-04	mg/kg/day	1.2E-04
			Exp. Route Total								2.0E-08					1.2E-04
		Exposure Point Total									1.2E-07					7.4E-04
	Exposure Medium Total										1.2E-07					7.4E-04
Soil Total											1.2E-07					7.4E-04
											Total of Receptor Risks Across All Media					1.2E-07					Total of Receptor Hazards Across All Media					7.4E-04

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	6.3E-08	mg/kg/day	1.5E+00	1/mg/kg-day	9.5E-08	1.8E-07	mg/kg/day	3.0E-04	mg/kg/day	6.1E-04
			Exp. Route Total								9.5E-08					6.1E-04
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	7.6E-09	mg/kg/day	1.5E+00	1/mg/kg-day	1.1E-08	2.2E-08	mg/kg/day	3.0E-04	mg/kg/day	7.3E-05
			Exp. Route Total								1.1E-08					7.3E-05
		Exposure Point Total									1.1E-07					6.9E-04
	Exposure Medium Total										1.1E-07					6.9E-04
Soil Total											1.1E-07					6.9E-04
											Total of Receptor Risks Across All Media 1.1E-07					Total of Receptor Hazards Across All Media 6.9E-04

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	4.1E-08	mg/kg/day	1.5E+00	1/mg/kg-day	6.1E-08	2.9E-07	mg/kg/day	3.0E-04	mg/kg/day	9.6E-04
			Exp. Route Total								6.1E-08					9.6E-04
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	5.3E-09	mg/kg/day	1.5E+00	1/mg/kg-day	7.9E-09	3.7E-08	mg/kg/day	3.0E-04	mg/kg/day	1.2E-04
			Exp. Route Total								7.9E-09					1.2E-04
		Exposure Point Total									6.9E-08					1.1E-03
	Exposure Medium Total										6.9E-08					1.1E-03
Soil Total											6.9E-08					1.1E-03
Total of Receptor Risks Across All Media											6.9E-08	Total of Receptor Hazards Across All Media				1.1E-03

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.5.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	NA		NA		NA	1.2E-06	mg/kg/day	3.0E-04	mg/kg/day	4.1E-03
			Exp. Route Total								0.0E+00					4.1E-03
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	NA		NA		NA	1.5E-07	mg/kg/day	3.0E-04	mg/kg/day	4.9E-04
			Exp. Route Total								0.0E+00					4.9E-04
		Exposure Point Total									0.0E+00					4.6E-03
	Exposure Medium Total										0.0E+00					4.6E-03
Soil Total											0.0E+00					4.6E-03
											Total of Receptor Risks Across All Media	0.0E+00		Total of Receptor Hazards Across All Media		4.6E-03

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.6.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	NA		NA		NA	1.2E-05	mg/kg/day	3.0E-04	mg/kg/day	3.9E-02
			Exp. Route Total								0.0E+00					3.9E-02
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	NA		NA		NA	9.7E-07	mg/kg/day	3.0E-04		3.2E-03
			Exp. Route Total								0.0E+00					3.2E-03
		Exposure Point Total									0.0E+00					4.2E-02
	Exposure Medium Total										0.0E+00					4.2E-02
Soil Total											0.0E+00					4.2E-02
											Total of Receptor Risks Across All Media	0.0E+00		Total of Receptor Hazards Across All Media		4.2E-02

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.7.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	1.4E-06	mg/kg/day	1.5E+00	1/mg/kg-day	2.1E-06	NA		NA		NA
			Exp. Route Total								2.1E-06					0.0E+00
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	1.3E-07	mg/kg/day	1.5E+00	1/mg/kg-day	2.0E-07	NA		NA		NA
			Exp. Route Total								2.0E-07					0.0E+00
		Exposure Point Total									2.3E-06					0.0E+00
	Exposure Medium Total										2.3E-06					0.0E+00
Soil Total											2.3E-06					0.0E+00
										Total of Receptor Risks Across All Media	2.3E-06			Total of Receptor Hazards Across All Media		0.0E+00

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.8.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	Surface Soil	Ingestion	Arsenic	9.1E-01	mg/kg	6.1E-08	mg/kg/day	1.5E+00	1/mg/kg-day	9.1E-08	4.3E-06	mg/kg/day	3.0E-04	mg/kg/day	1.4E-02
			Exp. Route Total								9.1E-08					1.4E-02
			Dermal Absorption[1]	Arsenic	9.1E-01	mg/kg	2.5E-09	mg/kg/day	1.5E+00	1/mg/kg-day	3.8E-09	1.8E-07	mg/kg/day	3.0E-04	mg/kg/day	5.8E-04
			Exp. Route Total								3.8E-09					5.8E-04
		Exposure Point Total									9.5E-08					1.5E-02
	Exposure Medium Total										9.5E-08					1.5E-02
Soil Total											9.5E-08					1.5E-02
											Total of Receptor Risks Across All Media					9.5E-08					Total of Receptor Hazards Across All Media					1.5E-02

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic.

TABLE 7.9.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	4.5E-07	mg/kg/day	NA	1/mg/kg-day	NA	1.3E-06	mg/kg/day	4.0E-04	mg/kg/day	3.2E-03
				Arsenic	1.4E+00	mg/kg	4.8E-07	mg/kg/day	1.5E+00	1/mg/kg-day	7.2E-07	1.3E-06	mg/kg/day	3.0E-04	mg/kg/day	4.5E-03
			Exp. Route Total								7.2E-07					7.6E-03
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	3.0E-09	mg/kg/day	NA	1/mg/kg-day	NA	8.3E-09	mg/kg/day	6.0E-05	mg/kg/day	1.4E-04
				Arsenic	1.4E+00	mg/kg	9.5E-08	mg/kg/day	1.5E+00	1/mg/kg-day	1.4E-07	2.7E-07	mg/kg/day	3.0E-04	mg/kg/day	8.9E-04
			Exp. Route Total								1.4E-07					1.0E-03
		Exposure Point Total									8.6E-07					8.7E-03
	Exposure Medium Total										8.6E-07					8.7E-03
Soil* Total											8.6E-07					8.7E-03
											Total of Receptor Risks Across All Media					8.7E-03

* = Surface soil and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 7.10.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	9.4E-08	mg/kg/day	NA	1/mg/kg-day	NA	2.6E-07	mg/kg/day	4.0E-04	mg/kg/day	6.6E-04
				Arsenic	1.4E+00	mg/kg	1.0E-07	mg/kg/day	1.5E+00	1/mg/kg-day	1.5E-07	2.8E-07	mg/kg/day	3.0E-04	mg/kg/day	9.3E-04
			Exp. Route Total								1.5E-07					1.6E-03
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	6.2E-10	mg/kg/day	NA	1/mg/kg-day	NA	1.7E-09	mg/kg/day	6.0E-05	mg/kg/day	2.9E-05
				Arsenic	1.4E+00	mg/kg	2.0E-08	mg/kg/day	1.5E+00	1/mg/kg-day	3.0E-08	5.5E-08	mg/kg/day	3.0E-04	mg/kg/day	1.8E-04
			Exp. Route Total								3.0E-08					2.1E-04
		Exposure Point Total									1.8E-07					1.8E-03
	Exposure Medium Total										1.8E-07					1.8E-03
Soil* Total											1.8E-07					1.8E-03
											Total of Receptor Risks Across All Media	1.8E-07		Total of Receptor Hazards Across All Media		1.8E-03

Soil* = combined surface and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 7.11.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	9.0E-08	mg/kg/day	NA	1/mg/kg-day	NA	2.6E-07	mg/kg/day	4.0E-04	mg/kg/day	6.6E-04
				Arsenic	1.3E+00	mg/kg	9.0E-08	mg/kg/day	1.5E+00	1/mg/kg-day	1.4E-07	2.6E-07	mg/kg/day	3.0E-04	mg/kg/day	8.8E-04
			Exp. Route Total								1.4E-07					1.5E-03
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	3.6E-10	mg/kg/day	NA	1/mg/kg-day	NA	1.0E-09	mg/kg/day	6.0E-05	mg/kg/day	1.7E-05
				Arsenic	1.4E+00	mg/kg	1.1E-08	mg/kg/day	1.5E+00	1/mg/kg-day	1.7E-08	3.3E-08	mg/kg/day	3.0E-04	mg/kg/day	1.1E-04
			Exp. Route Total								1.7E-08					1.3E-04
		Exposure Point Total									1.5E-07					1.7E-03
	Exposure Medium Total										1.5E-07					1.7E-03
Soil* Total											1.5E-07					1.7E-03
											Total of Receptor Risks Across All Media	1.5E-07		Total of Receptor Hazards Across All Media		1.7E-03

Soil* = combined surface and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 7.12.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	5.8E-08	mg/kg/day	NA	1/mg/kg-day	NA	4.1E-07	mg/kg/day	4.0E-04	mg/kg/day	1.0E-03
				Arsenic	1.4E+00	mg/kg	6.2E-08	mg/kg/day	1.5E+00	1/mg/kg-day	9.3E-08	4.3E-07	mg/kg/day	3.0E-04	mg/kg/day	1.4E-03
			Exp. Route Total								9.3E-08					2.5E-03
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	2.5E-10	mg/kg/day	NA	1/mg/kg-day	NA	1.8E-09	mg/kg/day	6.0E-05	mg/kg/day	2.9E-05
				Arsenic	1.4E+00	mg/kg	8.0E-09	mg/kg/day	1.5E+00	1/mg/kg-day	1.2E-08	5.6E-08	mg/kg/day	3.0E-04	mg/kg/day	1.9E-04
			Exp. Route Total								1.2E-08					2.2E-04
		Exposure Point Total									1.1E-07					2.7E-03
	Exposure Medium Total										1.1E-07					2.7E-03
Soil* Total											1.1E-07					2.7E-03
											Total of Receptor Risks Across All Media					1.1E-07					Total of Receptor Hazards Across All Media					2.7E-03

Soil* = combined surface and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 7.13.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	NA		NA		NA	1.8E-06	mg/kg/day	4.0E-04	mg/kg/day	4.4E-03
				Arsenic	1.4E+00	mg/kg	NA		NA		NA	1.9E-06	mg/kg/day	3.0E-04	mg/kg/day	6.3E-03
			Exp. Route Total								0.0E+00					1.1E-02
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	NA		NA		NA	7.1E-09	mg/kg/day	6.0E-05	mg/kg/day	1.2E-04
				Arsenic	1.4E+00	mg/kg	NA		NA		NA	2.3E-07	mg/kg/day	3.0E-04	mg/kg/day	7.5E-04
			Exp. Route Total								0.0E+00					8.7E-04
		Exposure Point Total									0.0E+00					1.2E-02
	Exposure Medium Total										0.0E+00					1.2E-02
Soil Total											0.0E+00					1.2E-02
											Total of Receptor Risks Across All Media					0.0E+00					Total of Receptor Hazards Across All Media		1.2E-02

Soil* = combined surface and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 7.14.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	NA		NA		NA	1.7E-05	mg/kg/day	4.0E-04	mg/kg/day	4.1E-02
				Arsenic	1.4E+00	mg/kg	NA		NA		NA	1.8E-05	mg/kg/day	3.0E-04	mg/kg/day	5.9E-02
			Exp. Route Total								0.0E+00					1.0E-01
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	NA		NA		NA	4.6E-08	mg/kg/day	6.0E-05	mg/kg/day	7.7E-04
				Arsenic	1.4E+00	mg/kg	NA		NA		NA	1.5E-06	mg/kg/day	3.0E-04	mg/kg/day	4.9E-03
			Exp. Route Total								0.0E+00					5.7E-03
		Exposure Point Total									0.0E+00					1.1E-01
	Exposure Medium Total										0.0E+00					1.1E-01
Soil* Total											0.0E+00					1.1E-01
											Total of Receptor Risks Across All Media					0.0E+00					Total of Receptor Hazards Across All Media	1.1E-01

Soil* = combined surface and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 7.15.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	2.0E-06	mg/kg/day	NA	1/mg/kg-day	NA	NA		NA		NA
				Arsenic	1.4E+00	mg/kg	2.1E-06	mg/kg/day	1.5E+00	1/mg/kg-day	3.2E-06	NA		NA		NA
			Exp. Route Total								3.2E-06					0.0E+00
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	6.4E-09	mg/kg/day	NA	1/mg/kg-day	NA	NA		NA		NA
				Arsenic	1.4E+00	mg/kg	2.0E-07	mg/kg/day	1.5E+00	1/mg/kg-day	3.1E-07	NA		NA		NA
			Exp. Route Total								3.1E-07					0.0E+00
		Exposure Point Total									3.5E-06					0.0E+00
	Exposure Medium Total										3.5E-06					0.0E+00
Soil* Total											3.5E-06					0.0E+00
Total of Receptor Risks Across All Media											3.5E-06	Total of Receptor Hazards Across All Media				0.0E+00

Soil* = combined surface and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 7.16.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC[2]		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Total Soil	Total Soil	Total Soil	Ingestion	Antimony	1.3E+00	mg/kg	8.7E-08	mg/kg/day	NA	1/mg/kg-day	NA	6.1E-06	mg/kg/day	4.0E-04	mg/kg/day	1.5E-02
				Arsenic	1.4E+00	mg/kg	9.2E-08	mg/kg/day	1.5E+00	1/mg/kg-day	1.4E-07	6.4E-06	mg/kg/day	3.0E-04	mg/kg/day	2.1E-02
			Exp. Route Total								1.4E-07					3.7E-02
			Dermal Absorption[1]	Antimony	1.3E+00	mg/kg	1.2E-10	mg/kg/day	NA	1/mg/kg-day	NA	8.3E-09	mg/kg/day	6.0E-05	mg/kg/day	1.4E-04
				Arsenic	1.4E+00	mg/kg	3.8E-09	mg/kg/day	1.5E+00	1/mg/kg-day	5.7E-09	2.7E-07	mg/kg/day	3.0E-04	mg/kg/day	8.9E-04
			Exp. Route Total								5.7E-09					1.0E-03
		Exposure Point Total									1.4E-07					3.8E-02
	Exposure Medium Total										1.4E-07					3.8E-02
Soil* Total											1.4E-07					3.8E-02
											Total of Receptor Risks Across All Media 1.4E-07					Total of Receptor Hazards Across All Media 3.8E-02

Soil* = combined surface and subsurface soil

Notes:

1. Dermal absorption factors (DABs) used to calculated dermal absorption intake from soil are chemical specific. DABS of 0.03 used for Arsenic, and DABS or 0.001 used for Antimony (i.e., default value for inorganics).

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	4.7E-07	NA	9.4E-08	5.7E-07	Skin, Vascular	3.0E-03	NA	5.8E-04	3.5E-03
			Chemical Total	4.7E-07	0.0E+00	9.4E-08	5.7E-07		3.0E-03	0.0E+00	5.8E-04	3.5E-03
		Exposure Point Total					5.7E-07					3.5E-03
	Exposure Medium Total						5.7E-07					3.5E-03
Medium Total							5.7E-07					3.5E-03
Receptor Total							5.7E-07			Receptor HI Total		3.5E-03

HI - Hazard Index

Total Skin HI Across All Media =	3.5E-03
Total Vascular HI Across All Media =	3.5E-03

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	9.9E-08	NA	2.0E-08	1.2E-07	Skin, Vascular	6.1E-04	NA	1.2E-04	7.4E-04
			Chemical Total	9.9E-08	0.0E+00	2.0E-08	1.2E-07		6.1E-04	0.0E+00	1.2E-04	7.4E-04
		Exposure Point Total					1.2E-07					7.4E-04
	Exposure Medium Total						1.2E-07					7.4E-04
Medium Total							1.2E-07					7.4E-04
Receptor Total							1.2E-07	Receptor HI Total				7.4E-04

HI - Hazard Index

Total Skin HI Across All Media =	7.4E-04
Total Vascular HI Across All Media =	7.4E-04

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	9.5E-08	NA	1.1E-08	1.1E-07	Skin, Vascular	6.1E-04	NA	7.3E-05	6.9E-04
			Chemical Total	9.5E-08	0.0E+00	1.1E-08	1.1E-07		6.1E-04	0.0E+00	7.3E-05	6.9E-04
		Exposure Point Total					1.1E-07					6.9E-04
	Exposure Medium Total						1.1E-07					6.9E-04
Medium Total							1.1E-07					6.9E-04
Receptor Total							1.1E-07	Receptor HI Total				6.9E-04

HI - Hazard Index

Total Skin HI Across All Media =	6.9E-04
Total Vascular HI Across All Media =	6.9E-04

TABLE 9.4.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Current/Future
Receptor Population: Trespasser
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	6.1E-08	NA	7.9E-09	6.9E-08	Skin, Vascular	9.6E-04	NA	1.2E-04	1.1E-03
			Chemical Total	6.1E-08	0.0E+00	7.9E-09	6.9E-08		9.6E-04	0.0E+00	1.2E-04	1.1E-03
		Exposure Point Total					6.9E-08					1.1E-03
	Exposure Medium Total						6.9E-08					1.1E-03
Medium Total							6.9E-08					1.1E-03
Receptor Total							6.9E-08		Receptor HI Total			1.1E-03

HI - Hazard Index

Total Skin HI Across All Media =	1.1E-03
Total Vascular HI Across All Media =	1.1E-03

TABLE 9.5.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	4.1E-03	NA	4.9E-04	4.6E-03
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		4.1E-03	0.0E+00	4.9E-04	4.6E-03
		Exposure Point Total					0.0E+00					4.6E-03
	Exposure Medium Total						0.0E+00					4.6E-03
Medium Total							0.0E+00					4.6E-03
Receptor Total							0.0E+00			Receptor HI Total		4.6E-03

HI - Hazard Index

Total Skin HI Across All Media =	4.6E-03
Total Vascular HI Across All Media =	4.6E-03

TABLE 9.6.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	3.9E-02	NA	3.2E-03	4.2E-02
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		3.9E-02	0.0E+00	3.2E-03	4.2E-02
		Exposure Point Total					0.0E+00					4.2E-02
	Exposure Medium Total						0.0E+00					4.2E-02
Medium Total							0.0E+00					4.2E-02
Receptor Total							0.0E+00			Receptor HI Total		4.2E-02

HI - Hazard Index

Total Skin HI Across All Media =	4.2E-02
Total Vascular HI Across All Media =	4.2E-02

TABLE 9.7.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	2.1E-06	NA	2.0E-07	2.3E-06	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	2.1E-06	0.0E+00	2.0E-07	2.3E-06		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					2.3E-06					0.0E+00
	Exposure Medium Total						2.3E-06					0.0E+00
Medium Total							2.3E-06					0.0E+00
Receptor Total							2.3E-06	Receptor HI Total				0.0E+00

TABLE 9.8.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	Surface Soil	Arsenic	9.1E-08	NA	3.8E-09	9.5E-08	Skin, Vascular	1.4E-02	NA	5.8E-04	1.5E-02
			Chemical Total	9.1E-08	0.0E+00	3.8E-09	9.5E-08		1.4E-02	0.0E+00	5.8E-04	1.5E-02
		Exposure Point Total					9.5E-08					1.5E-02
	Exposure Medium Total						9.5E-08					1.5E-02
Medium Total							9.5E-08					1.5E-02
Receptor Total							9.5E-08			Receptor HI Total		1.5E-02

HI - Hazard Index

Total Skin HI Across All Media =	1.5E-02
Total Vascular HI Across All Media =	1.5E-02

TABLE 9.9.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	3.2E-03	NA	1.4E-04	3.3E-03
			Arsenic	7.2E-07	NA	1.4E-07	8.6E-07	Skin, Vascular	4.5E-03	NA	8.9E-04	5.4E-03
			Chemical Total	7.2E-07	0.0E+00	1.4E-07	8.6E-07		7.6E-03	0.0E+00	1.0E-03	8.7E-03
		Exposure Point Total					8.6E-07					8.7E-03
	Exposure Medium Total						8.6E-07					8.7E-03
Medium Total							8.6E-07					8.7E-03
Receptor Total							8.6E-07			Receptor HI Total		8.7E-03

HI - Hazard Index

Total Blood HI Across All Media =	3.3E-03
Total Skin HI Across All Media =	5.4E-03
Total Vascular HI Across All Media =	5.4E-03

TABLE 9.10.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	6.6E-04	NA	2.9E-05	6.9E-04
			Arsenic	1.5E-07	NA	3.0E-08	1.8E-07	Skin, Vascular	9.3E-04	NA	1.8E-04	1.1E-03
			Chemical Total	1.5E-07	0.0E+00	3.0E-08	1.8E-07		1.6E-03	0.0E+00	2.1E-04	1.8E-03
		Exposure Point Total					1.8E-07					1.8E-03
	Exposure Medium Total						1.8E-07					1.8E-03
Medium Total							1.8E-07					1.8E-03
Receptor Total							1.8E-07	Receptor HI Total				1.8E-03

HI - Hazard Index

Total Blood HI Across All Media =	6.9E-04
Total Skin HI Across All Media =	1.1E-03
Total Vascular HI Across All Media =	1.1E-03

TABLE 9.11.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	6.6E-04	NA	1.7E-05	6.7E-04
			Arsenic	1.4E-07	NA	1.7E-08	1.5E-07	Skin, Vascular	8.8E-04	NA	1.1E-04	9.9E-04
			Chemical Total	1.4E-07	0.0E+00	1.7E-08	1.5E-07		1.5E-03	0.0E+00	1.3E-04	1.7E-03
		Exposure Point Total					1.5E-07					1.7E-03
	Exposure Medium Total						1.5E-07					1.7E-03
Medium Total							1.5E-07					1.7E-03
Receptor Total							1.5E-07		Receptor HI Total			1.7E-03

HI - Hazard Index

Total Blood HI Across All Media =	6.7E-04
Total Skin HI Across All Media =	9.9E-04
Total Vascular HI Across All Media =	9.9E-04

TABLE 9.12.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Trespasser
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	1.0E-03	NA	2.9E-05	1.1E-03
			Arsenic	9.3E-08	NA	1.2E-08	1.1E-07	Skin, Vascular	1.4E-03	NA	1.9E-04	1.6E-03
			Chemical Total	9.3E-08	0.0E+00	1.2E-08	1.1E-07		2.5E-03	0.0E+00	2.2E-04	2.7E-03
		Exposure Point Total					1.1E-07					2.7E-03
	Exposure Medium Total						1.1E-07					2.7E-03
Medium Total							1.1E-07					2.7E-03
Receptor Total							1.1E-07			Receptor HI Total		2.7E-03

HI - Hazard Index

Total Blood HI Across All Media =	1.1E-03
Total Skin HI Across All Media =	1.6E-03
Total Vascular HI Across All Media =	1.6E-03

TABLE 9.13.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	4.4E-03	NA	1.2E-04	4.5E-03
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	6.3E-03	NA	7.5E-04	7.0E-03
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.1E-02	0.0E+00	8.7E-04	1.2E-02
		Exposure Point Total					0.0E+00					1.2E-02
	Exposure Medium Total						0.0E+00					1.2E-02
Medium Total							0.0E+00					1.2E-02
Receptor Total							0.0E+00				Receptor HI Total	1.2E-02

HI - Hazard Index

Total Blood HI Across All Media =	4.5E-03
Total Skin HI Across All Media =	7.0E-03
Total Vascular HI Across All Media =	7.0E-03

TABLE 9.14.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	4.1E-02	NA	7.7E-04	4.2E-02
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	5.9E-02	NA	4.9E-03	6.3E-02
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.0E-01	0.0E+00	5.7E-03	1.1E-01
		Exposure Point Total					0.0E+00					1.1E-01
	Exposure Medium Total						0.0E+00					1.1E-01
Medium Total							0.0E+00					1.1E-01
Receptor Total							0.0E+00				Receptor HI Total	1.1E-01

HI - Hazard Index

Total Blood HI Across All Media =	4.2E-02
Total Skin HI Across All Media =	6.3E-02
Total Vascular HI Across All Media =	6.3E-02

TABLE 9.15.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Arsenic	3.2E-06	NA	3.1E-07	3.5E-06	Skin, Vascular	NA	NA	NA	0.0E+00
			Chemical Total	3.2E-06	0.0E+00	3.1E-07	3.5E-06		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					3.5E-06					0.0E+00
	Exposure Medium Total						3.5E-06					0.0E+00
Medium Total							3.5E-06					0.0E+00
Receptor Total							3.5E-06	Receptor HI Total				0.0E+00

TABLE 9.16.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Former 1,000-Inch Ranch (Amphibiuos Base Area) - UXO-15

Camp Lejeune, Jacksonville, NC

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	Total Soil	Antimony	NA	NA	NA	0.0E+00	Blood	1.5E-02	NA	1.4E-04	1.5E-02
			Arsenic	1.4E-07	NA	5.7E-09	1.4E-07	Skin, Vascular	2.1E-02	NA	8.9E-04	2.2E-02
			Chemical Total	1.4E-07	0.0E+00	5.7E-09	1.4E-07		3.7E-02	0.0E+00	1.0E-03	3.8E-02
		Exposure Point Total					1.4E-07					3.8E-02
	Exposure Medium Total						1.4E-07					3.8E-02
Medium Total							1.4E-07					3.8E-02
Receptor Total							1.4E-07		Receptor HI Total			3.8E-02

HI - Hazard Index

Total Blood HI Across All Media =	1.5E-02
Total Skin HI Across All Media =	2.2E-02
Total Vascular HI Across All Media =	2.2E-02

Appendix C
NCDENR Checklist for Ecological Assessments/Sampling

CHECKLIST FOR ECOLOGICAL ASSESSMENTS/SAMPLING

I. SITE LOCATION

1. Site Name: United States Marine Corps Base, Camp Lejeune, North Carolina
   US EPA ID Number: _____
   Location: Former 1,000 Inch Range (Amphibious Base Area – UXO-15)
   County: Onslow City: Jacksonville State: North Carolina

2. Latitude: 34°35'22.89 N Longitude: 77º22'46.96 W

3. Attach site maps, including a topographical map, a diagram which illustrates the layout of the facility (e.g., site boundaries, structures, etc.), and maps showing all habitat areas identified in Section III of the checklist. Also, include maps which illustrate known and suspected release areas, sampling locations and any other important features, if available.

   Figures 2-1, and 2-3 of this PA/SI report present topography, site boundaries and habitat. Sample locations are presented in Figure 3-1.

II. SITE CHARACTERIZATION

1. Indicate the approximate area of the site (i.e., acres or sq. ft.) 9 acres

2. Is this the first site visit? ☑ Yes ❑ No
   If no, attach trip report of previous site visit(s), if available.

   Dates(s) of previous site visit(s).

3. Are aerial or other site photographs available? ☑ Yes ❑ No
   If yes, please attach any available photo(s) to the site map to the report.
   Figure 2-1 of this PA/SI report.

4. Provide an approximate breakdown of the land uses on the site:

_____% Heavy Industrial	_5_% Light Industrial	_____% Urban
_____% Residential	_____% Rural	_____% Agricultural[b]
_____% Recreational[a]	_45_% Undisturbed	_50__% Other[c]

   [a]For recreational areas, please describe the use of the area (e.g., park, playing field, etc).
   _____

   [b]For agricultural areas, please list the crops and/or livestock which are present.
   _____

   [c]For areas designated as "other," please describe the use of the area.
   There are open fields in the areas previously disturbed by vehicle performance checks.

5. Provide an approximate breakdown of the land uses in the area surrounding the site.
   Indicate the radius (in miles) of the area described: 0.5 mile radius

_____% Heavy Industrial	_20_% Light Industrial	_____% Urban
_____% Residential	_____% Rural	_____% Agricultural[b]
_____% Recreational[a]	_80_% Undisturbed	_____% Other [c]

[a]For recreational areas, please describe the use of the area (e.g., park, playing field, golf course, etc).
_____

[b]For agricultural areas, please list the crops and/or livestock which are present.
_____

[c]For areas designated as "other," please describe the use of the area.
_____
_____

6. Has any movement of soil taken place at the site? ☑ Yes ❑ No
If yes, indicate the likely source of the disturbance, (e.g., erosion, agricultural, mining, industrial activities, removals, etc.) degree of disturbance, and estimate when these events occurred.
Soil was disturbed during the construction of the parking lot located in the northeastern quadrant of the Former 1,000 Inch Range. In addition, soil has been disturbed immediately south of the Former 1,000 Inch Range. Piles of soil are located adjacent to a small pond. The pond appears to be manmade. Water may have collected due to the placement of soils.

7. Do any sensitive environmental areas exist adjacent to or in proximity to the site, (e.g. Federal and State parks, National and State monuments, wetlands)? Yes *Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information. See Table 1 for a list of contacts.*

Please provide the source(s) of information used to identify these sensitive areas, and indicate their general location on the site map.

To the east of the site, wetlands are located along a creek that flows into Courthouse Bay. United States Marine Corps Base, Camp Lejeune, North Carolina INRMP, 2006.

8. What type of facility is located at the site?

❑ Chemical ❑ Manufacturing ❑ Mixing ❑ Waste Disposal

X Other (specify) The Former Amphibian Base was used to assess the performance of track vehicles. The area was also part of the Joint College Training Area. Vehicle activity and training occurred in the bare ground areas on Figure 2-1. Live fire is no longer used on the former '1,000-Inch Range', blanks and training pyrotechnics are used in training exercises (Richardson, 2008)

9. Identify the contaminants of potential concern (COPCs) at the site. If known, include the maximum contaminant levels. Please indicate the source of data cited (e.g., RFI, confirmatory sampling, etc). Detected soil concentrations found during the 2008 sampling investigation:

Chemical	Maximum Concentration	Units
ANTIMONY	8.9E-01	MG/KG
ARSENIC	2.1E+00	MG/KG
COPPER	1.4E+01	MG/KG
LEAD	3.0E+01	MG/KG
ZINC	4.0E+01	MG/KG

10. Check any potential routes of off-site migration of contaminants observed at the site:

❑ Swales ❑ Depressions ❑ Drainage Ditches

❑ Runoff ❑ Windblown Particulates ❑ Vehicular Traffic

❑ Other (specify):

11. Indicate the approximate depth to groundwater (in feet below ground surface [(bgs)].
Depth to groundwater ranged from 1 foot bgs (SB-41), 2-3 feet bgs in the vicinity of soil borings SB-33 to SB-37 and SB-25 to SB-29, and 4-5 feet bgs in the vicinity of SB-30, SB-31, SB-43, SB-44, and SB-57. Groundwater was not encountered at a depth of 5-6 feet bgs in the remaining soil borings.

12. Indicate the direction of groundwater flow (e.g., north, southeast, etc.)
Toward Courthouse Bay, south to southeast.

13. Is the direction of surface runoff apparent from site observations? ❑ Yes ☑ No
If yes, to which of the following does the surface runoff discharge? Indicate all that apply.

❑ Surface water ❑ Groundwater ❑ Sewer

❑ Collection Impoundment

14. Is there a navigable water body or tributary to a navigable water body?

☑ Yes ❑ No

15. Is there a water body anywhere on or in the vicinity of the site? If yes, also complete Section III.B.1: Aquatic Habitat Checklist -- Non-Flowing Systems and/or Section III.B.2: Aquatic Habitat Checklist -- Flowing Systems.

☑ Yes (approx. distance A small freshwater pond area is located immediately south of the Former 1,000 Inch Range (Near SB-41). A tidal creek and bordering wetlands are located 0.25 mile east of the investigation area. The creek is a tributary to Courthouse Bay, located 0.5 mile to the south of the site. The creek, wetlands, and pond are not expected to be significantly affected by site activities and will not be investigated.

❑ No

16. Is there evidence of flooding? ❑ Yes ☑ No
Wetlands and flood plains are not always obvious. Do not answer "no" without confirming information. If yes, complete Section III.C: Wetland Habitat Checklist.

17. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying fauna. (Use a blank sheet if additional space is needed for text.)

18. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? ❑ Yes ☑ No
If yes, you are required to verify this information with the U.S. Fish and Wildlife Service or other appropriate agencies (see Table 1 for a list of contacts). If species' identities are known, please list them next.

19. Record weather conditions at the site at the time of the site visit when information for completion of this checklist was prepared:

DATE December 2008

45°F Temperature (°C/°F)

Wind (direction/speed):

Cloud Cover: Mostly sunny

Normal daily high temperature (°C/°F):

Precipitation (rain, snow): One day of rain and two days of drizzle.

20. Describe reasonable and likely future land and/or water use(s) at the site.
Marine Corps Base (MCB) Camp Lejeune is currently planning industrial use to support the Boat Basin. A parking lot has been constructed in the northeast corner of the site for use by the Boat Basin.

21. Describe the historical uses of the site. Include information on chemical releases that may have occurred as a result of previous land uses. For each chemical release, provide information on the form of the chemical released (i.e., solid, liquid, vapor) and the known or suspected causes or mechanism of the release (i.e., spills, leaks, material disposal, dumping, explosion, etc.).

Small arms, including M1 rifles, .30 caliber and possibly .45 caliber pistols were usually fired at the 1,000 inch range (Richardson, 2008). The Courthouse Bay Amphibious Area (including the '1,000-Inch Range') was used by the Amphibian Assault Battalion to assess the performance of track vehicles and was part of the Joint College Training Area.

22. Identify the media (e.g., soil [surface or subsurface], surface water, air, groundwater) which are known or suspected to contain COCs.
Soil

II.A. SUMMARY OF OBSERVATIONS AND SITE SETTING

Include information on significant source areas and migration pathways that are likely to constitute complete exposure pathways.
Soil exposure may be a complete pathway.

Checklist Completed by Demitria Dickman

Affiliation CH2M HILL Ecological Risk Assessor

Author Assisted by Theron Grim (CH2M HILL) and Bob Brown (AGVIQ, LLC)

Date 02/09/09

III. HABITAT EVALUATION

III.A Terrestrial Habitat Checklist

III.A.1 Wooded

Are any wooded areas on or adjacent to the site? ☑ Yes ❑ No

If yes, indicate the wooded area on the attached site map and answer the following questions. If more than one wooded area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual wooded area. Distinguish between wooded areas by using names or other designations, and clearly identify each area on the site map.
If no, proceed to Section III.A.2: Shrub/Scrub

Wooded Area Questions

☑ On-site ❑ Off-site

Name or Designation: Former 1,000 Inch Range (Amphibious Base Area – UXO-15)

1. Estimate the approximate size of the wooded area (_45_% __)
   Please identify what information was used to determine the wooded area of the site (e.g., direct observation, photos, etc).

2. Indicate the dominant type of vegetation in the wooded area. Provide photographs, if available.

   ❑ Evergreen
   ❑ Deciduous
   ☑ Mixed

   Dominant plant species, if known: Thick understory; Loblolly Pine (*Pinus taeda*)

3. Estimate the vegetation density of the wooded area.

   ☑ Dense (i.e., greater than 75% vegetation)
   ❑ Moderate (i.e., 25% to 75% vegetation)
   ❑ Sparse (i.e., less than 25% vegetation)

4. Indicate the predominant size of the trees at the site. Use diameter at breast height.

   ☑ 0-6 inches
   ☑ 6-12 inches
   ❑ >12 inches
   ❑ No single size range is predominant

5. Specify type of understory present, if known. Provide a photograph, if available.

III.A.2 Shrub/Scrub

Are any shrub/scrub areas on or adjacent to the site? ❑ Yes ☑ No

If yes, indicate the shrub/scrub area on the attached site map and answer the following questions. If more than one shrub/scrub area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual shrub/scrub area. Distinguish between shrub/scrub areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.3: Open Field

Shrub/Scrub Area Questions

❑ On-site ❑ Off-site

Name or Designation: _____

1. Estimate the approximate size of the shrub/scrub area (_____% _____acres). Please identify what information was used to determine the shrub/scrub area of the site (e.g., direct observation, photos, etc).

2. Indicate the dominant type of shrub/scrub vegetation present, if known.
_____
_____

3. Estimate the vegetation density of the shrub/scrub area.

❑ Dense (i.e., greater than 75% vegetation)
❑ Moderate (i.e., 25% to 75% vegetation)
❑ Sparse (i.e., less than 25% vegetation)

4. Indicate the approximate average height of the scrub/shrub vegetation.

❑ 0-2 feet
❑ 2-5 feet
❑ >5 feet

5. Specify type of understory present, if known. Provide a photograph, if available.

III.A.3 Open Field

Are any open field areas on or adjacent to the site? ☑ Yes ❑ No

If yes, indicate the open field area on the attached site map and answer the following questions. If more than one open field area is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual open field area. Distinguish between open field areas, using names or other designations, and clearly identify each area on the site map.

If no, proceed to Section III.A.4: Miscellaneous

Open Field Area Questions

☑ On-site ❑ Off-site

Name or Designation: _Former 1,000 Inch Range (Amphibious Base Area – UXO-15)

1. Estimate the approximate size of the open field area (__50_% _____acres). Please identify what information was used to determine the open field area of the site.

2. Indicate the dominant type of vegetation present, if known.
_____
_____

3. Estimate the vegetation density of the shrub/scrub area.

☑ Dense (i.e., greater than 75% vegetation)
❑ Moderate (i.e., 25% to 75% vegetation)
❑ Sparse (i.e., less than 25% vegetation)

5. Indicate the approximate average height of the dominant plant: 5-6 feet

III.A.4 Miscellaneous

Are other types of terrestrial habitats present at the site, other than woods, scrub/shrub and open field?
❑ Yes ☑ No

If yes, indicate the area on the attached site map and answer the following questions. If more than one of these areas are present on or adjacent to the site, make additional copies of the following questions and fill out for each individual area. Distinguish between areas by using names or other designations. Clearly identify each area on the site map.

If no, proceed to Section III.B: Aquatic Habitats.

Miscellaneous Area Questions

❑ On-site ❑ Off-site

Name or Designation: _____

1. Provide a description of the terrestrial miscellaneous habitat and identify the area on the site map.

2. Estimate the approximate size of the area (_____% _____acres)

3. What observations, if any, were made at the site regarding the presence and/or absence of insects, birds, mammals, etc.?
   _____
   _____
   _____
   _____

4. Review the questions in Section I to determine if any additional habitat checklists should be completed for this site.

III.B Aquatic Habitats

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

III.B.1 Non-Flowing Systems

Are any non-flowing aquatic features (such as ponds or lakes) located at or adjacent to the site?

☑ Yes ❑ No

If yes, indicate the aquatic feature on the attached site map and answer the following questions regarding the non-flowing aquatic features. If more than one non-flowing aquatic feature is present on or adjacent to the site, make additional copies of the following questions and fill out for each individual aquatic feature. Distinguish between aquatic features by using names or other designations. Clearly identify each area on the site map.

If no, proceed to Section III.B.2: Flowing Systems

Non-Flowing Aquatic Feature Questions

❑ On-site ☑ Off-site

Name or Designation: _____

1. Indicate the type of aquatic feature present:

   ❑ Natural (e.g., pond or lake)
   ☑ Man-made (e.g., impoundment, lagoon, canal, etc.)

2. Estimate the approximate size of the water body (in acres or sq. ft.) ~1 acre

3. If known, indicate the depth of the water body (in ft. or in.). On the northern edge, less than a foot; unknown farther into the water body._____

4. If a water body is present, what are its known uses (e.g.: recreation, navigation, etc.)?

   None known.

5. Is aquatic vegetation present? ☑ Yes ❑ No
   If yes, please identify the type of vegetation present if known.

   ☑ Emergent ❑ Submergent ❑ Floating

6. Indicate the general composition of the bottom substrate. Mark all sources that apply from the following list.

❑ Bedrock	☑ Sand	❑ Concrete
❑ Boulder (>10 in.)	❑ Silt	❑ Debris
❑ Cobble (2.5 - 10 in.)	❑ Clay	❑ Detritus
❑ Gravel (0.1 - 2.5 in.)	❑ Muck (fine/black)	

   ❑ Other (please specify):_____

7. Indicate the source(s) of the water in the aquatic feature. Mark all sources that apply from the following list.

   ❑ River/Stream/Creek
   ☑ Groundwater
   ❑ Industrial Discharge
   ☑ Surface Runoff
   ❑ Other (please specify):_____

8. Is there a discharge from the facility to the aquatic feature? ❑ Yes ❑ No Unknown
   If yes, describe the origin of each discharge and its migration path.
   Surface runoff from the southern portion of the site potentially flows into the ponded area during heavy rain events. However, no defined drainage routes were observed during the site visit. This potential mechanism of transport is not expected to be significant.

9. Does the aquatic feature discharge to the surrounding environment? ❑ Yes ☑ No

If yes, indicate the features from the following list into which the aquatic feature discharges, and indicate whether the discharge occurs onsite or offsite:

- ❑ River/Stream/Creek ❑ on-site ❑ off-site
- ❑ Groundwater ❑ on-site ❑ off-site
- ❑ Wetland ❑ on-site ❑ off-site
- ❑ Impoundment ❑ on-site ❑ off-site
- ❑ Other (please describe)_____

10. Identify any field measurements and observations of water quality that were made. Provide the measurement and the units of measure in the appropriate space below:

_____ Area

_____ Depth (average)

_____ Temperature (depth of water where the reading was taken) _____

_____ pH

_____ Dissolved oxygen

_____ Salinity

Clear_ Turbidity (clear, slightly turbid, turbid, opaque)
(Secchi disk depth_____)

_____ Other (specify)

11. Describe observed color and area of coloration.

12. Mark the open-water, non-flowing system on the site map attached to this checklist.

13. What observations, if any, were made at the water body regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc?
Small flying invertebrates and crawling invertebrates (spiders) were noted around the ponded area.

III.B.2 Flowing Systems

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section III.C, Wetland Habitat Checklist.

Are any flowing aquatic features (such as streams or rivers) located at or adjacent to the site?

❑ Yes ☑ No

If yes, indicate the system on the attached site map and answer the following questions regarding the flowing system. If more than one flowing system is present on or adjacent to the site, make additional copies of the following questions and complete one set for each individual aquatic feature. Distinguish between flowing systems by using names or other designation. Clearly identify each area on the site map

If no, proceed to Section III.C: Wetlands Habitats.

Flowing Aquatic Systems Questions

❑ On-site ❑ Off-site

Name or Designation: _____

1. Indicate the type of flowing aquatic feature present.

   ❑ River
   ❑ Stream/Creek/Brook
   ❑ Intermittent stream
   ❑ Artificially created (ditch, etc.)
   ❑ Channeling
   ❑ Other (specify)

2. For natural systems, are there any indicators of physical alteration (e.g., channeling, debris, etc.)?
   ❑ Yes ❑ No
   If yes, please describe the indicators observed.

3. Indicate the general composition of the bottom substrate.

❑ Bedrock	❑ Sand (course)	❑ Concrete
❑ Boulder (>10 in.)	❑ Silt (fine)	❑ Debris
❑ Cobble (2.5 - 10 in.)	❑ Clay (slick)	❑ Detritus
❑ Gravel (0.1 - 2.5 in.)	❑ Muck (fine/black)	❑ Marl (Shells)

   ❑ Other (please specify):_____

4. Describe the condition of the bank (e.g., height, slope, extent of vegetative cover).
   _____
   _____
   _____
   _____

5. Is the system influenced by tides? ❑ Yes ❑ No
   What information was used to make this determination?

6. Is the flow intermittent? ❑ Yes ❑ No
   If yes, please note the information used to make this determination.

7. Is there a discharge from the site to the water body? ❑ Yes ❑ No
   If yes, describe the origin of each discharge and its migration path.
   _____
   _____
   _____
   _____

8. Indicate the discharge point of the water body. Specify name of the discharge, if known.
   _____
   _____

9. Identify any field measurements and observations of water quality that were made.
   Provide the measurement and the units of measure in the appropriate space below:

_____ Width (ft.)

_____ Depth (average)

_____ Velocity (specify units):_____

_____ Temperature (depth of water where the reading was taken) _____

_____ pH

_____ Dissolved oxygen

_____ Salinity

_____ Turbidity (clear, slightly turbid, turbid, opaque)

(Secchi disk depth_____)

_____ Other (specify)

10. Describe observed color and area of coloration.

11. Is any aquatic vegetation present? ❑ Yes ❑ No
If yes, please identify the type of vegetation present, if known.

❑ Emergent ❑ Submergent ❑ Floating

12. Mark the flowing water system on the attached site map.

13. What observations were made at the water body regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc?

III.C Wetland Habitats

Are any wetland[1] areas such as marshes or swamps on or adjacent to the site?

❑ Yes ☑ No

If yes, indicate the wetland area on the attached site map and answer the following questions regarding the wetland area. If more than one wetland area is present on or adjacent to the site, make additional copies of the following questions and fill out one for each individual wetland area. Distinguish between wetland areas by using names or other designations (such as location). Clearly identify each area on the site map. Also, obtain and attach a National Wetlands Inventory Map (or maps) to illustrate each wetland area.

Identify the sources of the observations and information (e.g., National Wetland Inventory, Federal or State Agency, USGS topographic maps) used to make the determination whether or not wetland areas are present.

_____
_____
_____

If no wetland areas are present, proceed to Section III.D: Sensitive Environments and Receptors.

[1]Wetlands are defined in 40 CFR §232.2 as " Areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Examples of typical wetlands plants include: cattails, cordgrass, willows and cypress trees. National wetland inventory maps may be available at http:\\nwi.fws.gov. Additional information on wetland delineation criteria is also available from the Army Corps of Engineers.

Wetland Area Questions

❑ On-site ❑ Off-site

Name or Designation: _____

1. Indicate the approximate area of the wetland (acres or ft.^{2})_____

2. Identify the type(s) of vegetation present in the wetland.

   ❑ Submergent (i.e., underwater) vegetation
   ❑ Emergent (i.e., rooted in the water, but rising above it) vegetation
   ❑ Floating vegetation
   ❑ Scrub/shrub
   ❑ Wooded
   ❑ Other (Please describe):_____

3. Provide a general description of the vegetation present in and around the wetland (height, color, etc). Provide a photograph of the known or suspected wetlands, if available.
   _____
   _____
   _____

4. Estimate the vegetation density of the wetland area.

   ❑ Dense (i.e., greater than 75% vegetation)
   ❑ Moderate (i.e., 25% to 75% vegetation)
   ❑ Sparse (i.e., less than 25% vegetation)

5. Is standing water present? ❑ Yes ❑ No
   If yes, is the water primarily: ❑ Fresh ❑ Brackish
   Indicate the approximate area of the standing water (ft.^{2}) _____
   Indicate the approximate depth of the standing water, if known (ft. or in.)_____

6. Identify any field measurements and observations of water quality that were made. Provide the measurement and the units of measure in the appropriate space below:

   _____ Area
   _____ Depth (average)
   _____ Temperature (depth of water where the reading was taken) _____
   _____ pH
   _____ Dissolved oxygen
   _____ Salinity
   _____ Turbidity (clear, slightly turbid, turbid, opaque)
   (Secchi disk depth_____)
   _____ Other (specify)

7. Describe observed color and area of coloration.
   _____
   _____
   _____

8. If known, indicate the source of the water in the wetland.

- ❑ Stream/River/Creek/Lake/Pond
- ❑ Flooding
- ❑ Groundwater
- ❑ Surface runoff

9. Is there a discharge from the site to the wetland? ❑ Yes ❑ No
If yes, please describe:
_____
_____
_____

10. Is there a discharge from the wetland? ❑ Yes ❑ No
If yes, to what water body is discharge released?

- ❑ Marine (Name:_____)
- ❑ Surface stream/River (Name:_____)
- ❑ Lake/Pond (Name:_____)
- ❑ Groundwater
- ❑ Not sure

11. Does the area show evidence of flooding? ❑ Yes ❑ No
If yes, indicate which of the following are present (mark all that apply).

- ❑ Standing water
- ❑ Water-saturated soils
- ❑ Water marks
- ❑ Buttressing
- ❑ Debris lines
- ❑ Mud cracks
- ❑ Other (Please describe):_____

11. If a soil sample was collected, describe the appearance of the soil in the wetland area. Circle or write in the best response.

Color (blue/gray, brown, black, mottled) _____

Water content (dry, wet, saturated/unsaturated) _____

13. Mark the observed wetland area(s) on the attached site map.

III.D Sensitive Environments and Receptors

1. Do any other potentially sensitive environmental areas[2] exist adjacent to or within one-half mile of the site? If yes, list these areas and provide the source(s) of information used to identify sensitive areas. *Do not answer "no" without confirmation from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.* _Jurisdictional wetlands are located adjacent to the creek, 0.25 mile east of the site. United States Marine Corps Base, Camp Lejeune, North Carolina INRMP, 2006.
_____
_____

[3] Areas that provide unique and often protected habitat for wildlife species. These areas are typically used during critical life stages such as breeding, hatching, rearing of young and overwintering. Refer to Table 2 at the end of this document for examples of sensitive environments.

2. Are any areas on or near (i.e., within one-half mile) the site owned or used by local tribes? If yes, describe.
_No_____

3. Does the site serve or potentially serve as a habitat, foraging area or refuge by rare, threatened, endangered, candidate and/or proposed species (plants or animals), or any otherwise protected species? If yes, identify species. *This information should be obtained from the U.S. Fish and Wildlife Service and other appropriate agencies. See Table 1 for a list of contacts.* _No, as described in Section 5 of the Site Investigation Work Plan, CH2M HILL, 2008 and in the Marine Corps Base, Camp Lejeune, North Carolina INRMP, 2006.

4. Is the site potentially used as a breeding, roosting or feeding area by migratory bird species? If yes, identify which species.

_Unknown_____

5. Is the site used by any ecologically[3], recreationally or commercially important species? If yes, explain.
_No_____

IV. EXPOSURE PATHWAY EVALUATION

1. Do existing data provide sufficient information on the nature, rate and extent of contamination at the site?

☑ Yes
❑ No
❑ Uncertain

Please provide an explanation for your answer. Data were collected from soil across the site, providing representative information for the area of concern._____

2. Do existing data provide sufficient information on the nature, rate and extent of contamination in offsite affected areas?

☑ Yes
❑ No
❑ Uncertain
❑ No offsite contamination

[3] Ecologically important species include populations of species which provide a critical (i.e., not replaceable) food resource for higher organisms. These species' functions would not be replaced by more tolerant species or perform a critical ecological function (such as organic matter decomposition) and will not be replaced by other species. Ecologically important species include pest and opportunistic species that populate an area if they serve as a food source for other species, but do not include domesticated animals (e.g., pets and livestock) or plants/animals whose existence is maintained by continuous human interventions (e.g., fish hatcheries, agricultural crops, etc).

Please provide an explanation for your answer. Metals detected is site soils were present at low concentrations, posing no risk.

3. Do existing data address potential migration pathways of contaminants at the site?

☑ Yes
❑ No
❑ Uncertain

Please provide an explanation for your answer. Data were collected across the site. Almost all samples had concentrations below screening values.

4. Do existing data address potential migration pathways of contaminants in offsite affected areas?

❑ Yes
❑ No
❑ Uncertain
☑ No offsite contamination

Please provide an explanation for your answer Data were collected across the site. Almost all samples had concentrations below screening values. No significant migration and accumulation off-site is expected.

5. Are there visible indications of stressed habitats or receptors on or near (i.e., within one-half mile) the site that may be the result of a chemical release? If yes, explain. Attach photographs if available. No

6. Is the location of the contamination such that receptors might be reasonably expected to come into contact with it? For soil, this means contamination in the soil 0 to 1 foot below ground surface (bgs). If yes, explain.
Metals were detected in surface soil where receptors may be exposed.

7. Are receptors located in or using habitats where chemicals exist in air, soil, sediment or surface water? If yes, explain.
The undeveloped area is habitat for terrestrial receptors.

8. Could chemicals reach receptors via groundwater? Can chemicals leach or dissolve to groundwater? Are chemicals mobile in groundwater? Does groundwater discharge into receptor habitats? If yes, explain.
The groundwater is assumed to discharge to Courthouse Bay downgradient of the site. Should the low level concentrations migrate from soil to groundwater; concentrations will likely dilute and attenuate to the extent that aquatic receptors would not be at risk.

9. Could chemicals reach receptors through runoff or erosion? Answer the following questions.
Based on the low levels of contaminants detected in site soils, not significant transport and accumulation in waterbodies is expected (pond, creek/wetlands, and Courthouse Bay).

What is the approximate distance from the contaminated area to the nearest watercourse?

❑ 0 feet (i.e., contamination has reached a watercourse)
❑ 1-10 feet
❑ 11-20 feet
❑ 21-50 feet

- ❑ 51-100 feet
- ❑ 101-200 feet
- ❑ > 200 feet
- ❑ > 500 feet
- ☑ > 1000 feet

What is the slope of the ground in the contaminated area?

- ☑ 0-10%
- ❑ 10-30%
- ❑ > 30%

What is the approximate amount of ground and canopy vegetative cover in the contaminated area?

- ❑ < 25%
- ❑ 25-75%
- ☑ > 75%

Is there visible evidence of erosion (e.g., a rill or gully) in or near the contaminated area?

- ❑ Yes
- ☑ No
- ❑ Do not know

Do any structures, pavement or natural drainage features direct run-on flow (i.e., surface flows originating upstream or uphill from the area of concern) into the contaminated area?

- ❑ Yes
- ☑ No
- ❑ Do not know

10. Could chemicals reach receptors through the dispersion of contaminants in air (e.g., volatilization, vapors, fugitive dust)? If yes, explain.

_No_____

_____
_____

11. Could chemicals reach receptors through migration of non-aqueous phase liquids (NAPLs)? Is a NAPL present at the site that might be migrating towards receptors or habitats? Could NAPL discharge contact receptors or their habitat?

_No_____
_____
_____

TABLE 1
SENSITIVE ENVIRONMENT CONTACTS

CONTACT	TELEPHONE #	SENSITIVE ENVIRONMENT
NC Division of Parks and Recreation – National Heritage Program	(919) 733-4181 Fax: (919) 715-3085	State Parks Areas Important to Maintenance of Unique Natural Communities Sensitive Areas Identified Under The National Estuary Program Designated State Natural Areas State Seashore, Lakeshore, and River Recreational Areas Rare species (state and federal Threatened and Endangered) Sensitive Aquatic Habitat
NC Planning and Natural Resources	(919) 846-9991	State Wild & Scenic Rivers
National Park Service Public Affairs Office	(404) 562-3103	National Seashore, Lakeshore and River Recreational Areas National Parks or Monuments
Internet	www.nps.gov/rivers	Federal Designated Wild & Scenic Rivers
US Forest Service	(828) 257-4253	Designated and Proposed Federal Wilderness and Natural Areas
	(828) 257-4864	National Preserves and Forests
	(828) 257-4810	Federal Land Designated for the protection of natural ecosystems.
NC Division of Water Quality	(919) 733-6510	Critical Areas Identified Under the Clean Lakes Program
	(919) 733-5083 *Ask for Clean Water Act 305b report*	State-Designated Areas for Protection or Maintenance of Aquatic Life

TABLE 1
SENSITIVE ENVIRONMENT CONTACTS

CONTACT	TELEPHONE #	SENSITIVE ENVIRONMENT
NC Division of Forest Resources	(919) 733-2162 x 234	State Preserves and Forests
US Fish & Wildlife Service	(919) 856-4520 x 11	Terrestrial Areas Utilized for Breeding by Large or Dense Aggregations of Animals
NC Wildlife Resources Commission	(252) 451-2534	National or State Wildlife Refuges
NOAA	(301) 713-3145 x 173	Marine Sanctuaries
NC Department of Cultural Resources	(919) 733-4763	National and State Historical Sites
NC Division of Coastal Management Internet	(919) 733-2293 http://dcm2.enr.state.nc.us	Areas Identified Under Coastal Protection Legislation Coastal Barriers or Units of a Coastal Barrier Resources System
NC Wildlife Resources Commission	(919) 733-3633	Spawning Areas Critical for the Maintenance of Fish/Shellfish Species within River, Lake or Coastal Tidal Waters. Migratory Pathways and Feeding Areas Critical for Maintenance of Anadromous Fish Species within River Reaches or Areas in Lakes or Coastal Tidal Waters in Which such Fish Spend Extended Periods of Time State Lands Designated for Wildlife or Game Management
US Army Corps of Engineers	(919) 876-8441, ext. 28	Wetlands

TABLE 2
EXAMPLES OF SENSITIVE ENVIRONMENTS

National Parks and National Monuments

Designated or Administratively Proposed Federal Wilderness Areas

National Preserves

National or State Wildlife Refuges

National Lakeshore Recreational Areas

Federal land designated for protection of natural ecosystems

State land designated for wildlife or game management

State designated Natural Areas

Federal or state designated Scenic or Wild River

All areas that provide or could potentially provide critical habitat[1] for state and federally listed Threatened or Endangered Species, those species that are currently petitioned for listing, and species designated by other agencies as sensitive or species of concern.

Marine Sanctuary

Areas identified under the Coastal Zone Management Act

Sensitive areas identified under the National Estuary Program or Near Coastal Waters Program

Critical areas identified under the Clean Lakes Program

National Seashore Recreational Area

Habitat known to be used by Federal designated or proposed endangered or threatened species

Unit of Coastal Barrier Resources System

Coastal Barrier (undeveloped)

Spawning areas critical for the maintenance of fish/shellfish species within river, lake, or coastal tidal waters

Migratory pathways and feeding areas critical for maintenance of andromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time

Terrestrial areas utilized for breeding by large or dense aggregations of animals

National river reach designated as Recreational

Habitat known to be used by state designated endangered or threatened species

Habitat known to be used by species under review as to its Federal endangered or threatened status

Coastal Barrier (partially developed)

Particular areas, relatively small in size, important to maintenance of unique biotic communities

State-designated areas for protection or maintenance of aquatic life

Wetland

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1 Critical habitats are defined by the Endangered Species Act (50 CFR §424.02(d)) as:

> 1) Specific areas within the geographical area currently occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (i) essential to the conservation of the species and (ii) that may require special management considerations or protection, and
> 2) Specific areas outside the geographical area occupied by a species at the time it is listed upon a determination by the Secretary [of Interior] that such areas are essential for the conservation of the species.

TABLE F-1
Surface Soil Screening
Camp Lejeune Courthouse Bay Amphibious Area
Jacksonville, North Carolina

Chemical	Maximum Concentration[a]		Location	Average[b]	Units	Detection Ratio	Camp Lejeune Background SS 2X Mean	Ecological Screening Value	Hazard Quotient
PERCHLORATE	0.003	U	NA	0.001	MG/KG	0/64	NA	NA	NA
ANTIMONY	0.46	N	ASR2.19-SS49	0.435	MG/KG	2/64	0.447	0.27	**1.7**
ARSENIC	2.1		ASR2.19-SS23	0.818	MG/KG	64/64	0.626	18	0.1
COPPER	13.9	J	ASR2.19-SS60	1.407	MG/KG	57/64	4.83	28	0.5
LEAD	29.6		ASR2.19-SS08	5.391	MG/KG	64/64	12.3	11	**2.7**
ZINC	40.1		ASR2.19-SS40	5.327	MG/KG	64/64	10.8	46	0.9

NA - Not available
U - The material was analyed for, but not detected
J - The material was detected at the concentrations level below the detection limit.
a - One half of the detection limit is reported if not detected
b - Average concentrations calculated using one half of the detection limits when applicable
Bold - Concentration exceeded ecological screening value
mg/kg - milligram per kilogram