FINAL
WORK PLAN
REMEDIAL INVESTIGATION/FEASIBILITY STUDY

FORMER CAMP BUTNER
(RANGE COMPLEX 1, RANGE COMPLEX 2, ARMY NATIONAL GUARD PROPERTY, HAND GRENADE RANGE, AND FLAME THROWER RANGE)
GRANVILLE COUNTY, NORTH CAROLINA

CONTRACT NO. W912DY-10-D-0023
DELIVERY ORDER NO. 0009
FUDS PROJECT NO. I04NC000902

Prepared for

U.S. Army Corps of Engineers
U.S. Army Engineering and Support Center, Huntsville

Prepared by:

HydroGeoLogic, Inc.
11107 Sunset Hills Road
Suite 400
Reston, VA 20190

September 2012

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REMEDIAL INVESTIGATION/FEASIBILITY STUDY
MILITARY MUNITIONS RESPONSE SITES
FORMER CAMP BUTNER
GRANVILLE COUNTY, NORTH CAROLINA

SIGNATURE SHEET

CLIENT:	U.S. Army Engineering and Support Center, Huntsville
CONTRACT NO.:	W912DY-10-D-0023
TASK ORDER NO.:	0009
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TABLE OF CONTENTS

Page

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

Page

LIST OF TABLES

LIST OF FIGURES
(All figures can be found in Appendix B)

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

ADD	average daily dose
ADE	average daily exposure
AGM	analog geophysical mapping
AHA	activity hazard analysis
APP	Accident Prevention Plan
AR	Army Regulation
ARAR	applicable or relevant and appropriate requirement
ARNG	Army National Guard Property
ASR	Archives Search Report
ATF	Bureau of Alcohol, Tobacco, Firearms and Explosives
BDC	Bomb Data Center
BERA	baseline environmental risk assessment
bgs	below ground surface
BIP	blown-in-place
BRAC	Base Realignment and Closure
CAR	Corrective Action Request
CD	cultural debris
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESAS	USACE Savannah District
CESAW	USACE Wilmington District
CFR	Code of Federal Regulations
CO	Contracting Officer
COC	compound of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
COR	Contracting Officer's Representative
CSM	conceptual site model
CWM	chemical warfare materiel
DA	Department of the Army
DD	Decision Document
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DFOW	definable feature of work
DGM	digital geophysical mapping
DID	Data Item Description
DMM	discarded military munitions
DoD	Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

DQCR	Daily Quality Control Report
DQO	data quality objective
Eco-SSL	ecological soil screening level
EE/CA	Engineering Evaluation/Cost Analysis
ELAP	Environmental Laboratory Accreditation Program
EOD	explosive ordnance disposal
EPC	exposure point concentration
EPP	Environmental Protection Plan
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
ESA	Endangered Species Act
ESL	ecological screening level
ESP	Explosives Site Plan
ESTCP	Environmental Security Technology Certification Program
EZ	Exclusion Zone
FIR	food ingestion rate
FS	Feasibility Study
FSC	Federal Species of Concern
FSP	Field Sampling Plan
FTR	Flame Thrower Range
FUDS	Formerly Used Defense Site
GIS	Geographical Information System
GPO	geophysical prove-out
GPS	Global Positioning System
GSV	geophysical system verification
HA	hazard assessment
HAZMAT	hazardous material
HE	high explosive
HFD	hazardous fragment distance
HGL	HydroGeoLogic, Inc.
HGR	Hand Grenade Range
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
Hz	hertz
IAW	in accordance with
ID	inside diameter
IDW	investigation derived waste
IGD	interim guidance document

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

IRIS	Integrated Risk Information System
IS	incremental sampling
ISM	incremental sampling methodology
ISO	industry standard object
IVS	instrument verification strip
LOAEL	lowest observed adverse effect level
MC	munitions constituent
MD	munitions debris
MDAS	material documented as safe
MDEH	material documented as an explosive hazard
MEC	munitions and explosives of concern
MGFD	munitions with greatest fragmentation distance
MIS	multi-incremental sample
MDL	method detection limit
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MRA	munitions response area
MRS	munitions response site
MRSPP	munitions response site priority protocol
MSD	minimum separation distance
mV	millivolts
NCDENR	North Carolina Department of Environment and Natural Resources
NCNHP	North Carolina Natural Heritage Program
NCR	nonconformance report
NEC	National Electrical Code
NEW	net explosive weight
NOAEL	no observed adverse effect level
OE	ordnance and explosives
OESS	ordnance and explosives safety specialist
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
PAO	public affairs office
PDT	project delivery team
PIP	public involvement plan
PM	Project Manager
PMP	Project Management Plan
PP	Proposed Plan

PPCA	Plant Protection and Conservation Act
PPE	personal protective equipment
PPK	post-process kinematic
PQL	practical quantition limit
PRG	preliminary remediation goal
PWS	performance work statement
QA	quality assurance
QAPP	Quality Assurance Project Plan
QASP	Quality Assurance Surveillance Plan
QC	Quality Control
QCP	Quality Control Plan
RA	removal action
RAB	restoration advisory board
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RC1	Range Complex 1
RC2	Range Complex 2
RCRA	Resource Conservation and Recovery Act
RCWM	Recovered Chemical Warfare Materiel
RDX	cyclonite
RFD	remote firing device
RI	Remedial Investigation
RME	reasonable maximum exposure
ROE	right of entry
RRD	range related debris
RSL	Regional Screening Level
RTK	real-time kinematic
RTS	robotic total station
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SC	Special Concern
SDSFIE	Spatial Data Standards for Facilities, Infrastructure and Environment
SERDP	Strategic Environmental Research and Development Program
SIR	soil ingestion rate
SLERA	screening level ecological risk assessment
SOP	standard operating procedure
SR	Significantly Rare
SSHP	Site Safety and Health Plan
SU	sampling unit
SUF	seasonal use factor
SUXOS	Senior Unexploded Ordnance Supervisor

TBD	to be determined
TCRA	Time Critical Removal Action
TEC	Topographic Engineering Center
TNT	2,4,6-trinitrotoluene
TO	task order
TP	Technical Paper
TPP	technical project planning
TRV	toxicity reference value
TSD	team separation distance
TSERAWG	Tri-Services Environmental Risk Assessment Work Group
UCL	upper confidence level
UF	uncertainty factor
UFP	Uniform Federal Policy
USABTAG	U.S. Army Biological Technical Assistance Group
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAESCH	U.S. Army Engineer Support Center-Huntsville
USEPA	U.S. Environmental Protection Agency
UTM	Universal Transverse Mercator
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer
VSP	Visual Sampling Plan
WAAS	wide area augmentation system
WERS	Worldwide Environmental Remediation Services
WMA	Wildlife Management Area
WP	Work Plan

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FINAL
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MILITARY MUNITIONS RESPONSE SITES
FORMER CAMP BUTNER
BUTNER, GRANVILLE COUNTY, NORTH CAROLINA

1.0 INTRODUCTION

1.0.1 This Work Plan (WP) has been prepared by HydroGeoLogic, Inc. (HGL) for the U.S. Army Engineering Support Center, Huntsville (USAESCH) under Contract No. W912DY-10-D-0023, Task Order (TO) No. 0009, for munitions response sites (MRSs) at the former Camp Butner, Granville County, North Carolina. The site location map is shown on Figure 1.1. (All figures are presented in Appendix B.) This WP details the technical approach for completion of TO component activities and provides procedures to conduct a Remedial Investigation (RI)/Feasibility Study (FS) for the designated MRSs. The five MRSs included in the RI\FS are as follows:

- Range Complex 1 (RC1)
- Range Complex 2 (RC2)
- Army National Guard Property (ARNG)
- Hand Grenade Range (HGR)
- Flame Thrower Range (FTR)

1.0.2 Figure 1.2 shows the location of the five former Camp Butner RI\FS MRSs.

1.1 PROJECT AUTHORIZATION

1.1.1 HGL is performing this RI/FS for the USAESCH as part of a TO issued under HGL's Worldwide Environmental Remediation Services (WERS) contract. This RI/FS is being performed under the Military Munitions Response Program (MMRP), which was established under the Defense Environmental Restoration Program (DERP), and in accordance with (IAW) the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by Superfund Amendments and Reauthorization Act (SARA) of 1986, and National Oil and Hazardous Substances Contingency Plan requirements. RI\FS activities will be conducted with regulatory coordination, as appropriate, with the U.S. Environmental Protection Agency (EPA), Region 4, and the North Carolina Department of Environment and Natural Resources (NCDENR).

1.1.2 The MMRP was established in 2001 under DERP to address the safety, health, and environmental issues presented by munitions and explosives of concern (MEC) and munitions constituents (MCs) at defense sites. Defense sites known or suspected to contain MEC are called munitions response areas (MRAs), which consist of one or more MRSs.

1.1.3 The Army is the lead agency responsible for the RI/FS at the former Camp Butner MRSs. The lead regulatory agency is NCDENR. All activities involving work in areas potentially containing unexploded ordnance (UXO) hazards will be conducted consistent with the requirements of the USAESCH, U.S. Army Corps of Engineers (USACE), Department of the Army (DA) and Department of Defense (DoD) regarding personnel, equipment, and procedures.

1.2 PURPOSE AND SCOPE

1.2.1 The RI phase of the CERCLA process focuses on characterizing the nature and extent of contamination to support later evaluation of potential remedial approaches. A summary of the Camp Butner RI process is presented in Figure 1.3. The purpose of this RI is to determine the presence or absence of MEC and MC at each MRS and, if present, to determine the nature and extent of MEC/MC contamination. This information will be used to identify data gaps, update the conceptual site model (CSM), evaluate MEC hazards and human health and ecological risks, and update the munitions response site prioritization protocol (MRSPP). Results from the RI will be used to develop and evaluate remedial alternatives and to provide recommendations as part of an FS. The USAESCH performance work statement (PWS) for this TO is provided in Appendix A.

1.2.2 A review of previous investigation activities and their associated results and recommendations indicates that adequate data exists to characterize the nature and extent of MEC (whether UXO or DMM) and MC at the FTR and HGR MRSs; therefore, no additional fieldwork will be conducted during the RI at these two MRSs. However, supplemental documentation will be provided for these MRSs so that they may proceed through the CERCLA process to the Decision Document (DD) with the other three MRSs.

1.2.3 This WP presents the primary practices and procedures that will be used to obtain data during the project to support the analysis and design of potential response actions and to meet the overall objective of this RI/FS. During the project, data will be obtained to assess the following factors:

- Physical characteristics of the property;
- Characteristics/classification of soils, sediment, and groundwater;
- Characteristics of the MEC/MC (quantities, concentrations, toxicity, persistence, mobility, depth, nature and extent, etc.);
- Actual and potential pathways through environmental media;
- Actual and potential exposure routes; and
- Other factors such as sensitive populations that pertain to the characterization of the site or support the analysis of potential remedial action alternatives.

1.2.4 To ensure proper assessment of these factors, Data Quality Objectives will be established through the technical project planning (TPP) process and agreed upon by the PDT prior to receipt of Notice to Proceed from the USACE Contracting Officer. This WP presents the DQO process and identifies those DQOs required to characterize the nature and extent of MEC (either

UXO or DMM) and MC IAW the agreed-upon technical approach developed during the TPP meetings and discussions as documented in the TPP Memorandum (HGL, 2012).

1.2.5 Results from this RI will be used to develop and evaluate remedial alternatives as part of the FS. These data will be used to identify ARARs, preliminary remediation goals (PRGs), and remedial action objectives (RAOs); and to screen various technologies for the development of remedial alternatives.

1.2.6 The term MEC distinguishes specific categories of military munitions that may pose unique explosive safety risks. The following define MEC and MC criteria that will be used during the completion of the RI:

- UXO includes military munitions that fulfill the following criteria:
    - Have been primed, fuzed, armed, or otherwise prepared for action;
    - Have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and
    - Remain unexploded either by malfunction, design, or any other cause.
- Discarded military munitions (DMM) are military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include MEC, military munitions being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.
- MC includes any materials originating from UXO, DMM, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of ordnance or munitions.

1.3 PROJECT OBJECTIVES

1.3.1 The primary objective of this project is to achieve acceptance of a DD for each MRS IAW applicable regulations. This will be achieved by designing and completing an RI, evaluating alternatives for each MRS and documenting the results in an FS, and documenting decisions made by stakeholders in a Proposed Plan (PP) and DD.

1.3.2 The purpose of the RI is (1) to collect and analyze the data necessary to determine the nature and extent of MEC and MC contamination, and (2) to conduct a baseline risk assessment to quantify MC risk to human and ecological receptors and explosives safety hazards. The purpose of the FS is to ensure that appropriate remedial alternatives are developed and evaluated and that an appropriate remedy is selected. The FS is the mechanism for the development, screening, and detailed evaluation of alternative munitions response options that will result in timely and appropriate decisions for protecting human health, safety, and the environment.

1.4 WORK PLAN ORGANIZATION

1.4.1 This WP is prepared consistent with Data Item Description (DID) WERS-001.01 and is organized as noted below. Tables are presented at the end of each chapter, and figures are presented in Appendix B.

- Chapter 1 – Introduction
- Chapter 2 – Technical Management Plan
- Chapter 3 – Field Investigation Plan
- Chapter 4 – Quality Control Plan (QCP)
- Chapter 5 – Explosives Management Plan
- Chapter 6 – Environmental Protection Plan
- Chapter 7 – Property Management Plan
- Chapter 8 – Interim Holding Facility Siting Plan for Recovered Chemical Warfare Materiel (RCWM) Projects
- Chapter 9 – Physical Security Plan for RCWM Projects
- Chapter 10 – References
- Appendices:
  - Appendix A PWS
  - Appendix B Site Maps
  - Appendix C Points of Contact
  - Appendix D Accident Prevention Plan
  - Appendix E Quality Assurance Project Plan
  - Appendix F Forms
  - Appendix G HGL Personnel Qualification Certification Letter
  - Appendix H TPP Technical Memorandum and DQO Worksheets
  - Appendix I Standard Operating Procedures

1.5 PROJECT LOCATION

1.5.1 Camp Butner is located approximately 15 miles north of the city of Durham, within Butner and Granville Counties, North Carolina. The majority of the 40,384-acre former military installation consists of undeveloped land primarily used for agricultural purposes; however, limited portions of the property include residential development. This combination of land use is typified by localized cropland clearings located within expanses of woodland.

1.6 SITE DESCRIPTION

1.6.1 Site Location

1.6.1.1 <u>ARNG Property</u>

1.6.1.1.1 The ARNG is located in the west-central portion of the former Camp Butner. The land is owned by the State of North Carolina National Guard and is utilized as a training center. Approximately 50 percent of the ARNG property is located within Durham County, and it accounts for the majority of the former Camp Butner property within the county. The remaining portion of the ARNG property is located in Granville County.

1.6.1.2 RC1 and RC2

1.6.1.2.1 The range complexes comprise the northern portion of the former Camp Butner. The majority of the area is privately owned and is utilized for agricultural purposes. Most tracts of land are in excess of 200 acres. A large portion of the land is undeveloped and forested, with private residences located throughout the area. Timber harvesting is a common practice across this portion of the former Camp Butner area. The majority of the area is located in Granville County; the remaining portion is located within Durham and Person Counties.

1.6.1.3 FTR

1.6.1.3.1 The FTR is located in the southeast portion of the former Camp Butner. This area is near the town of Butner North Carolina, and two state hospitals, the John Umstead Hospital and the Murdock Center.

1.6.1.4 HGR

1.6.1.4.1 The HGR is located in the south-central portion of the former Camp Butner. The area is composed of pastureland owned by Umstead Farm, a North Carolina State University dairy research farm.

1.6.2 Topography

1.6.2.1 The terrain within the project site area is in the Piedmont Plateau physiographic province. The topography is characterized by rolling hills with moderate to steep slopes. Lake Butner (Holt Reservoir) is located in the south-central portion of the former Camp Butner and stretches northeast into National Guard property.

1.6.2.2 The vegetation in the undeveloped areas is primarily moderate to dense forest. The understory is predominantly dogwood, poison ivy, Christmas fern, and Japanese honeysuckle. Wooded areas typically consist of hardwoods and pine located throughout the hillsides. Vegetation in farmed areas consists of grasses and agricultural crops, often tobacco.

1.6.3 Climate

1.6.3.1 The project site is subject to warm, humid summers and mild winters. The lowest mean temperature of 28°F occurs in January, and the highest mean temperature of 90°F occurs in July. The annual average rainfall is approximately 47 inches, with an average monthly rainfall between 3 to 4 inches. The estimated maximum frost penetration for the general area is 4 inches.

1.6.4 Threatened and Endangered Species

1.6.4.1 Threatened and endangered species are addressed under Section 6.0 of this WP.

1.6.5 Cultural Resources

1.6.5.1 Cultural resources are addressed under Section 6.0 of this WP.

1.7 SITE HISTORY

1.7.1 Camp Butner was primarily established to train infantry, artillery, and engineering combat troops for deployment and redeployment overseas during World War II. The installation was active from 1942 until 1946; however, training was only conducted through 1943. The installation included approximately 15 live-fire ammunition training ranges, a grenade range, a 1,000-inch range, a gas chamber, and a flame thrower training pad. Munitions used at the site included 2.36-inch rockets, rifle and hand grenades, 20mm through 240mm high explosive (HE) projectiles, 60 and 81mm mortars, and antipersonnel practice mines. Training activities also included the use of demolition items such as TNT and various initiating and priming materials.

1.7.2 Following World War II, the camp was closed, limited ordnance clearances were performed, and the property was conveyed to the ARNG, the State of North Carolina, local municipalities, and private owners.

1.7.3 A brief summary of the site history for each of the RI/FS MRS locations has been included below. This information was obtained from the Archives Search Report (ASR) Supplement (ASR, 2004). Figures 1.4 and 1.5 illustrate areas investigated and types of munitions found since closure.

1.7.1 ARNG Property History

1.7.1.1 The ARNG portion of RC1 existed near the center of the site and contained an artillery impact area, two mortar ranges, and several small arms ranges. The range fan for the artillery impact area was confirmed using historical maps; however the dimensions of the other range fans were established using standard range fans for the individual type of range. All range fans remain within site boundaries, and some range fans overlap with others within the complex. Munitions found or suspected at the ARNG include small arms, 2.36-inch rockets, rifle grenades, 60mm mortars, 81mm mortars, 37mm projectiles, 105mm projectiles, and 155mm projectiles.

1.7.2 RC1 History

1.7.2.1 RC1 (excluding the ARNG property) existed near the center of the site and contained an artillery impact area, two mortar ranges, and several small arms ranges. All range fans remain within site boundaries, and some range fans overlap with others within the complex. Munitions types identified at this MRS included 2.36-inch rockets, hand grenades, rifle grenades, 37mm projectiles, 40mm projectiles, 57mm projectiles, 105mm projectiles, 155mm projectiles, 60mm mortars, and 81mm mortars

1.7.3 Range Complex 2 History

1.7.3.1 RC2 existed on the north side of the site and contained an artillery impact area, a mock village and two machine gun ranges. The range fan for the RC2 artillery impact area was also confirmed using historical maps; however the dimensions of the associated range fans were also established using standard range fans for the individual type of ranges. The range fan for the artillery impact area was taken from historical maps, while the remainder of the range fans used were standard range fans for the individual type of range. All range fans remain within site boundaries, and some range fans overlap with others within the complex. The entire complex is currently under private ownership. Munitions types identified at this MRS included 2.36-inch rockets, hand grenades, rifle grenades, 37mm projectiles, 40mm projectiles, 57mm projectiles, 105mm projectiles, 155mm projectiles, 60mm mortars, and 81mm mortars

1.7.4 FTR History

1.7.4.1 This range was used to conduct flame thrower training during World War II. The range was situated just north of the former cantonment area, but information concerning the layout of the range has not been located. The standard range fan for an FTR as given in TM 9-855, August 1944, was used for the range fan. The range fan does not extend beyond site boundaries or overlap other range fans.

1.7.5 HGR History

1.7.5.1 The HGR is believed to have been used during World War II for live hand grenade training. Therefore, the standard range fan for a live HGR as given in AR 750- 10, January 1944, was used. The range fan does not extend beyond site boundaries or overlap with other range fans. There have been no reported incidents of MEC on the range. DGM was conducted on 8.5 acres in and around the 5-acre HGR with 71 percent of the anomalies excavated and no MEC or MD discovered during the EE/CA. Therefore, the EE/CA indicates no further characterization is warranted based on the lack of ordnance-related findings.

1.8 CURRENT AND PROJECTED LAND USE

1.8.1 Currently, a large percentage of the land within the former Camp Butner site, with the exception of the Town of Butner, is undeveloped. Current land use assignments for the areas of the site encompassed by Durham, Granville, and Person Counties are predominantly agriculture/open space and residential/agriculture (less than 5 acres). Private land ownership parcels may exceed 200 acres in areas utilized for agriculture and forestry. Residential land use also makes up a significant percentage of the site and is typified by low-density development along main roads. The majority of these parcels are multi-use for a combination of agricultural and residential purposes. HGL will work with the USACE to obtain rights of entry (ROEs) to the various parcels of land scoped under the TO.

1.8.1 ARNG Property Current Land Use

1.8.1.1 The ARNG is currently used for Army National Guard training activities.

1.8.2 RC1 Current Land Use

1.8.2.1 RC1 is currently a mixture of undeveloped, residential single-family, and recreational use parcels.

1.8.3 RC2 Current Land Use

1.8.3.1 RC2 is currently a mixture of undeveloped, residential single-family, and recreational use parcels.

1.8.4 FTR Current Land Use

1.8.4.1 The FTR is currently undeveloped with limited residential development.

1.8.5 HGR Current Land Use

1.8.5.1 The HGR is currently undeveloped.

1.9 PREVIOUS INVESTIGATIONS OF SITE

1.9.1 The following section presents a summary of previous investigation and removal action activities conducted at each of the MRS locations being investigated during this RI/FS. A brief outline of the previous investigation activities is presented below:

- Annual Inspection (1958–1969)
- Historical Photographic Analysis (2001)
- Engineering Evaluation/Cost Analysis (EE/CA) (2004)
- Time Critical Removal Action (TCRA) at Lakeview Subdivision Blalock and Riley Properties (2003, 2004)
- Groundwater Monitoring Well MC Sampling and Characterization (2005)
- Soil and Sediment MC Sampling and Characterization (2006)
- Removal Action at the FTR (2006)
- Removal Actions at Lakeview Subdivision and Residential Parcels Distributed Throughout RC1 and RC2 (2008, 2009, 2010)

1.9.2 Table 1.1 presents a chronology of the previous investigation activities conducted at the Camp Butner MRSs, MRSs included in each investigation, and a summary of activities conducted during each investigation. HGL has incorporated all available data at the time of this RI project and all available data has been used for the technical approach development and planning purposes.

1.9.3 The Preliminary CSM Information presented in Table 1.2 summarizes previous DoD land use, previous investigation activities, potential MEC/MD presence, MEC/MD found since closure, previous investigation clearance activities, and current and future land use for the MRSs. The preliminary CSM was derived from review of previous investigation activities and will be updated by HGL based on the findings of the RI.

1.10 INITIAL SUMMARY OF MEC EXPLOSIVE SAFETY HAZARDS

1.10.1 Munitions types potentially present include 37mm, 40mm, 57mm, 105mm, 155mm, and 240mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades.

1.10.1 Munition with the Greatest Fragmentation Distance

1.10.1.1 The munitions with the greatest fragmentation distance (MGFD) for the ARNG, RC1, and RC2 is the 105mm M1 (TNT- filled) projectile. The MGFD for the three MRSs has a maximum fragmentation distance of 2,111 feet. The hazardous fragment distance (HFD) for the three MRSs was derived from the 105mm M393A3 projectile, and is 337 feet. The MGFD and HFD are based on the DoD Explosives Safety Board (DDESB) Fragmentation Database established by DDESB Technical Paper (TP) 16 (revised October 18, 2011) calculations.

1.10.2 Chemical Warfare Materials

1.10.2.1 The proposed MRSs are not a suspected of containing chemical warfare materiel (CWM). Section 3.8.2.1, Chemical Warfare Materiel provides a detailed description of the appropriate actions to be taken in the event of the unexpected discovery of CWM.

1.11 BACKGROUND CHARACTERIZATION

1.11.1 Inorganic constituents (metals) occurring in natural environmental media (surface soil) are regarded as “background” concentrations that are characteristic of uncontaminated conditions to the extent that site activities have not adversely impacted these media. The background concentrations are typically used during the assessment of site-related contamination (including risk assessments) to ensure that naturally occurring and non-site-related constituents are not unnecessarily carried forward through the assessments. Many metals-bearing compounds occur in nature and cannot readily be distinguished from site-related contamination without knowledge of metals concentrations in the unaffected (background) environmental media.

1.11.2 HGL will conduct environmental background sampling during RI field activities at the former Camp Butner to assess existing site conditions relative to naturally occurring ones. The purpose of the background characterization is to establish statistically valid background database concentrations for metals (copper, lead, zinc, and antimony) present in the surface soils that can be used during the RI/FS process. Field sampling will be conducted IAW this WP at locations agreed upon during the TPP phase.

1.11.3 Information regarding background metals concentrations present in the surface soils at the former Camp Butner does not exist; therefore, incremental sampling methodology (ISM) surface soil data will be collected during the proposed field investigation activities. HGL will use this data to conduct the screening and evaluation of inorganic soil concentrations detected during the Camp Butner RI.

TABLES

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Table 1.1
Summary of Previous Investigations

Investigation I.D.	Timeframe	MRS(s) Addressed	Summary of Activities
Annual Inspection	1958–1969		After Camp Butner was declared surplus, limited clearance operations were conducted from 1947 to 1950. After completion of these operations, six areas (A through F) requiring land restrictions (surface use only) were identified in MRSs RC1 and RC2 (see Figure 1.4). Annual inspections of these six areas (and "other" areas) were conducted between 1958 and 1969.
		RC2	Area A: Rifle grenade, 2.36-inch rockets; 37mm, 40mm, and 81mm mortars; and 105mm, 155mm, and 240mm projectiles
		RC1	Area B: 2.36-inch rockets and 81mm mortars Area C: 81mm mortars, and 37mm, 105mm, 155mm, and 240mm projectiles Area D: 2.36-inch rockets, and 37mm and 40mm projectiles Area E: 2.36-inch rockets Area F: No findings reported Other "Unrestricted" Areas: Hand grenades; 37mm, 40mm, 60mm, 81mm, 105mm, and 155mm projectiles; and 2.36-inch rockets
Historical Photographic Analysis (Geographical Information System [GIS] Based) by Topographic Engineering Center (TEC)	2001	RC1, RC2, ARNG, FTR, HGR	The 2001 GIS-based historical photographic analysis evaluated 1943, 1945, and 1949 aerial photography to identify MEC-related features (e.g., crater fields, targets, ground scars, etc.) and areas potentially contaminated with MEC and MC (TEC, 2001). Based on the historical aerial analysis and MEC/MD findings, HGL has generated an Interpreted Impact Area.
EE/CA	2001 (report dated in 2004 [Parsons, 2004])	RC1, RC2	The EE/CA evaluated 77 acres primarily utilizing digital geophysical mapping (DGM) to investigate 0.25-acre grids (approximately total of 330 grids). Grids were distributed throughout suspected former munitions use areas within RC1 and RC2. Intrusive results provided evidence that identified actual impact and munitions use areas. A total of 13 MEC and 1,485 MD items were recovered during the EE/CA. Munitions types identified at these MRSs included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades.
		HGR	At the HGR, approximately 8.5 acres were mapped using geophysical techniques and intrusively investigated. No MEC or MD items were identified; therefore, the EE/CA concluded that the nature and extent of MEC had been adequately characterized.

Table 1.1 (continued)
Summary of Previous Investigations

Investigation I.D.	Timeframe	MRS(s) Addressed	Summary of Activities
Well Sampling for MC	2004 (report in 2005, [USACE, 2005])	RC1, RC2, ARNG	During the groundwater sampling event, perchlorate concentrations were detected at relatively shallow depths (between 15 and 78 feet) in 12 of 23 drinking water wells, including detected concentrations at one off-site well location. Perchlorate was detected at concentrations that exceed project screening criteria at two well locations (well locations 2 and 21). Potential sources of groundwater contamination included munitions, flares, and the application of fertilizers or defoliants. One homeowner, whose drinking water well was sampled, confirmed the use of Bulldog Soda fertilizer at his residence. Bulldog Soda contains naturally occurring perchlorate concentrations. Lead concentrations were detected at nine well locations during the groundwater sampling activities. Lead was detected at concentrations that exceeded the project screening criteria at one unfiltered sample location (location 11) and at one filtered sample location (location 6). Lead typically adsorbs to sediment, and these detected concentrations could have been the result of elevated turbidity present in the samples. Other potential sources of lead at Camp Burner included munitions, water supply piping, gasoline, vehicle exhaust, and lead-based paint. Groundwater analytical results did not indicate that former DoD activities at Camp Butner had impacted the groundwater quality; however, perchlorate and lead concentrations detected in the groundwater warranted supplemental investigation.
Soil and Sediment MC Sampling	2006	RC1, RC2	In 2006 Camp Butner participated in an investigation to evaluate MC potentially present at World War I and World War II-era Formerly Used Defense Site (FUDS) locations. The objective was to collect, sample, analyze, and evaluate soil and surface water samples from six different FUDS locations. Sampling was biased toward heavy use target/impact areas, firing points, and low order detonations/exposed explosives locations. Soil samples were collected from HE impact craters. Thirteen soil samples (including one background) and three surface water samples were collected. Only lead was identified as a potential MC associated with former use. Lead was detected in soils at concentrations that exceed ecological screening values at 11 of the 13 sample locations, including the background sample location. Concentrations of explosive compounds were not detected in the soil or surface water.
Removal Action	2006	FTR	The 2006 RA conducted at the FTR cleared approximately 20 acres to depth of detection using analog techniques. These RA activities identified and disposed of two MEC items and 530 pounds of MD. Based on the results of the RA, the report concluded that the nature and extent of MEC at the FTR had been adequately characterized.

Table 1.1 (continued)
Summary of Previous Investigations

Investigation I.D.	Timeframe	MRS(s) Addressed	Summary of Activities
TCRA	2003, 2004	RC1	A TCRA was conducted at the Lakeview Residential Housing Subdivision within RC1 in 2003. Approximately 26 acres were intrusively investigated using analog techniques to a depth of 6-inches. MEC and MD were recovered. DGM was then conducted over areas previously investigated to a depth of 6 inches and identified additional anomalies. DGM was also conducted over additional subdivision areas (Blalock and Riley properties). A continuation of the TCRA, conducted in 2004, included the investigation of anomalies identified at the Blalock and Riley properties. Select DGM anomalies were cleared to depth of detection.
Removal Action	2008, 2009, and 2010	RC1, RC2	Portions of the Lakeview Subdivision previously cleared to only 6 inches were cleared to depth of detection. In addition, RA activities were completed at more than 250 parcels (average parcel was approximately 1.75 acres). Land parcel grids investigated were distributed throughout RC1 and RC2. RA activities were generally focused around existing residential dwellings. Intrusive results indicated the presence of former impact and munitions-use areas. Munitions recovered included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades.

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Table 1.2
Preliminary CSM Information

Area Name	Acres	Previous Land Use	Past Investigations, Munitions Found or Suspected	Current Land Use	Future Land Use
ARNG Property	4,824	ASR Supplement: Army National Guard Property is situation in the southwestern portion of RC1, which contained an artillery impact area, two mortar ranges, and several small arms ranges. All range fans remain within site boundaries, and some range fans overlap with others within the complex.	Munitions types expected and/or identified included small arms, 2.36-inch rockets; rifle grenades; 37mm, 57mm, 105mm, and 155mm projectiles; and 60mm and 81mm mortars based on data from the National Guard and the ASR. No known clearances.	ARNG Training	ARNG Training and Construction
RC1	12,363	ASR Supplement: RC1 (excluding Army National Guard property) existed near the center of the site and contained an artillery impact area, two mortar ranges, and several small arms ranges. All range fans remain within site boundaries ,and some range fans overlap with others within the complex.	Munitions types expected and/or identified included 37mm, 40mm, 57mm, 105mm, 155mm and 240mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 2001 EE/CA: The EE/CA evaluated 77 acres primarily utilizing DGM to investigate 0.25-acre grids (total of approximately 330 grids). Grids were distributed throughout suspected former munitions use areas within RC1 and RC2. Intrusive results provided an indication of actual impact/munitions use areas. A total of 13 MEC and 1,485 MD items were recovered during the EE/CA. 2003 TCRA: A TCRA was conducted at the Lakeview Residential Housing Subdivision within RC1 in 2003. Approximately 26 acres were intrusively investigated using analog techniques to a depth of 6 inches. MEC and MD were subsequently recovered. DGM was then conducted over areas previously investigated to a depth of 6 inches and identified additional anomalies. DGM was also conducted over additional subdivision areas (Blalock and Riley properties). A continuation of the TCRA conducted in 2004 included the investigation of anomalies identified at the Blalock and Riley properties. MEC-like DGM anomalies were cleared to depth of detection. 2008, 2009, 2010 Non-Time Critical Removal Actions: Portions of the Lakeview Subdivision previously cleared to a depth of only 6 inches were cleared to depth of detection. In addition, RA activities were completed at more than 250 parcels (average parcel was approximately 1.75 acres). Land parcel grids investigated were distributed throughout RC1 and RC2. RA activities were generally focused around existing residential dwellings. Intrusive results indicate the presence of former impact and munitions-use areas. Munitions recovered included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 1958-69 Annual Surface Inspections: Area B: 2.36-inch rockets and 81mm mortars Area C: 2.36-inch rockets, 81mm mortars, and 37mm, 105mm, 155mm, and 240mm projectiles Area D: 2.36-inch rockets, and 37mm and 40mm projectiles Area E: 2.36-inch rockets Area F: No findings reported Other “Unrestricted” Areas: Hand grenades; 37mm, 40mm, 60mm, 81mm, 105mm, and 155mm projectiles; and 2.36-inch rockets	Recreational, Residential-Single Family, Undeveloped	Recreational, Residential-Single Family, Undeveloped

Table 1.2 (continued)
Preliminary CSM Information

Area Name	Acres	Previous Land-Use	Past Investigations, Munitions Found or Suspected	Current Land Use	Future Land Use
RC2	11,529	ASR Supplement: RC2 existed on the north side of the site and contained an artillery impact area, a mock village, and two machine gun ranges. The range fan for the artillery impact area was taken from historical maps, while the remainder of the range fans used were standard range fans for the individual type of range. All range fans remain within site boundaries, and some range fans overlap with others within the complex. The entire complex is currently under private ownership. West Artillery Impact Area Rifle/Machine Gun Range 1 Rifle/Machine Gun Range 2 Mock German Village	Munitions types expected and/or identified included 37mm, 40mm, 57mm, 105mm, 155mm, and 240mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 2001 EE/CA: The EE/CA evaluated 77 acres primarily utilizing DGM to investigate 0.25-acre grids (total of approximately 330 grids). Grids were distributed throughout suspected former munitions use areas within RC1 and RC2. Intrusive results provided an indication of actual impact/munitions use areas. A total of 13 MEC and 1,485 MD items were recovered during the EE/CA. Munitions types identified at these MRSs included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 2008, 2009, 2010 Non-Time Critical Removal Actions: RA activities were completed at more than 250 parcels (average parcel was approximately 1.75 acres). Land parcel grids investigated were distributed throughout RC1 and RC2. RA activities were generally focused around existing residential dwellings. Intrusive results indicated the presence of former impact and munitions use areas. Munitions recovered included 37mm, 40mm, 57mm, 105mm, and 155mm projectiles;60mm and 81mm mortars; 2.36-inch rockets; and hand and rifle grenades. 1958-69 Annual Inspections: Area A: Rifle grenade, 2.36-inch rockets, and 37mm, 40mm, 81mm mortar, 105mm, 155mm, and 240mm projectiles	Recreational Residential-Single Family, Undeveloped	Recreational Residential-Single Family, Undeveloped
FTR	5	ASR Supplement: This range was used to conduct flame thrower training during World War II. The layout of the range is unknown. It existed just north of the former cantonment area. The standard range fan for a flame thrower range as given in TM 9-855, August 1944, was used for the range fan. The range fan does not extend beyond site boundaries or overlap other range fans.	RA: The 2006 RA conducted at the FTR cleared approximately 20 acres to depth of detection using analog techniques. The RA activities identified and disposed of two MEC items and 530 pounds of MD. Based on results of the RA, the nature and extent of MEC at the FTR have been adequately characterized.	Recreational, Residential-Single Family, Undeveloped	Recreational, Residential-Single Family, Undeveloped
HGR	25	ASR Supplement: The HGR is believed to have been used during World War II for live hand grenade training. Therefore, the standard range fan for a live hand grenade range as given in AR 750-10, January 1944, was used. The range fan does not extend beyond site boundaries or overlap with other range fans. There have been no reported incidents of ordnance and explosives on the range.	2001 EE/CA: Approximately 8.5 acres were mapped using geophysical techniques and intrusively investigated. No MEC or MD items were identified at the HGR during the EE/CA. Based on EE/CA results, the nature and extent of MEC has been adequately characterized. Potential: Mk II, Hand Grenade	Undeveloped	Undeveloped

2.0 TECHNICAL MANAGEMENT PLAN

2.0.1 This Technical Management Plan section details the organization, structure, roles, and functions of the project management team, and the approach, methods, and procedures that will be used for management of the RI/FS at Camp Butner. HGL has the primary responsibility for the execution of all aspects of the RI, including team integration, engineering, data and GIS management, cost control, program safety, quality control (QC), community relations, and subcontractor selection and management. HGL will coordinate all activities with the USAESCH, USACE Wilmington District (CESAW), USACE Savannah District (CESAS), EPA, NCDENR, and ARNG. The HGL Project Manager (PM) is responsible for executing the project in a timely and cost-effective manner. This will be accomplished by continually tracking project status. The Senior Unexploded Ordnance Supervisor (SUXOS) is responsible for oversight of RI field activities and will provide a summary of field problems and progress to the PM. A summary of the field activities completed will be reported to the USAESCH PM on a weekly basis while fieldwork is being conducted.

2.1 PROJECT ORGANIZATION

2.1.1 Several organizations are directly involved in the Camp Butner RI/FS project. An organizational chart depicting the various organizations and key personnel involved in the execution of the Camp Butner RI/FS is presented in Figure 2.1. The technical team consists of USAESCH, CESAW and CESAS, HGL, and HGL team member AMEC. The roles of each organization are described below. Table 2.1 summarizes the responsibilities for USAESCH, CESAW, CESAS, HGL, and AMEC.

2.1.1 USAESCH

2.1.1.1 USAESCH is the lead agency for this project, and its responsibilities include procurement of HGL's services, providing direction to HGL in execution of the project, and reviewing and coordinating the project plans and documents. USAESCH will also provide technical expertise for any ordnance and explosives (OE) activities. The USAESCH contracting officer (CO), Lydia Tadesse, is responsible for day-to-day monitoring of performance in areas of contract compliance and contract administration.

2.1.1.2 The USAESCH PM and CO's Representative (COR) for this project is Chris Cochrane. Ms. Cochrane is responsible for monitoring, assessing, recording, and reporting on the technical performance of HGL on a daily basis.

2.1.2 CESAW

2.1.2.1 The CESAW PM is the geographical PM for the RI/FS. The CESAW PM for the project is Ray Livermore. His responsibilities include coordination for site access (obtaining ROEs); review of project WPs and documents, communication with the news media and public, and coordination with state and local regulatory agencies.

2.1.3 CESAS

2.1.3.1 CESAS is the regional division supporting the CESAW in obtaining ROEs. CESAS will also support field investigation activities and provide an OE safety specialist (OESS) for the project.

2.1.4 HGL

2.1.4.1 HGL is the prime contractor to USAESCH and will provide all engineering support and services for the RI/FS activities at Camp Butner. HGL has subcontracted with AMEC to provide technical and field support for the project. HGL is responsible for performing all activities detailed in the PWS (Appendix A), including development of the Project Management Plan (PMP)/Quality Assurance (QA) Surveillance Plan (QASP); preparation of this WP; execution of all aspects of the RI and FS, including team integration, engineering, data and GIS management, cost control, program safety, QC, community relations, and subcontractor selection and management; and preparation of the RI and FS reports.

2.1.4.2 HGL will provide personnel to perform the required geophysical activities and to evaluate collected data. HGL will provide some of the UXO services needed to support these activities, and personnel from AMEC will supplement HGL personnel in the field. HGL will provide GIS services in the development of the CSM and maintain and manage all project and geospatial data. In addition, HGL will provide support to the public affairs office (PAO) and public meetings and update the Administrative Record as necessary. HGL will also complete the FS report, PP, and DD. As the prime contractor, HGL will be responsible for the work performed by AMEC and any other subcontractors utilized to complete RI/FS activities.

2.1.5 AMEC

2.1.5.1 AMEC will supplement HGL by providing resources and personnel during execution of the RI/FS. AMEC has extensive geophysical and human health/ecological risk assessment experience working with the DoD at MMRP sites throughout the country.

2.2 PROJECT PERSONNEL

2.2.1 The following sections describe the roles and responsibilities of the HGL project team personnel shown on the organization chart, Figure 2.1. All project personnel will meet the training and experience requirements for their assigned positions. The project support staff includes administrative personnel, contract administrators, risk assessors, technical editors, and information management specialists. A list of contact information for project personnel is provided in Appendix C.

2.2.1 HGL Program Manager

2.2.1.1 HGL's Program Manager, Janardan Patel, will oversee coordination and execution of project activities. Mr. Patel will participate in periodic project review meetings with the project staff and the USAESCH and will assess progress and ensure the availability of necessary resources to execute the project. Mr. Patel's primary functions include reviewing schedules, cost performance and status reports, and QA efforts.

2.2.2 HGL Project Manager

2.2.2.1 The HGL PM, Derek Anderson, will ensure that the project is executed safely and successfully and will oversee the delivery of high quality work products to the USAESCH. Mr. Anderson will oversee the costs, review the schedule, and coordinate timely completion of deliverables throughout the project. The PM will have the authority to commit personnel and corporate resources necessary to meet the performance objectives. Mr. Anderson will track and direct the technical and administrative elements of the project on a daily basis and will oversee the preparation and submission of project submittals. He will work with the USAESCH PM to plan and execute project work; to provide schedule and cost updates; and to oversee safety, field, and administrative tasks.

2.2.3 MEC Technical Manager

2.2.3.1 The MEC Technical Manager will be responsible for the execution of all RI activities in accordance with the PWS and the RI/FS WP while protecting worker health and safety. The Technical Manager will manage the RI field activities under the direction of the PM. This will include conducting daily safety meetings, scheduling and coordinating field team activities, and submitting a daily activities report to the PM. The Technical Manager will coordinate with the PM to take corrective actions to ensure that the schedules are being met. Responsibilities will also include enforcing compliance with the project Accident Prevention Plan (APP)/Site Safety and Health Plan (SSHP), and general field operating procedures. Mr. Larry Hudgins of AMEC is the designated MEC Technical Manager for this project.

2.2.4 Geophysical Personnel

2.2.4.1 The geophysical team will consist of a senior geophysicist, project geophysicist, and trained geophysical survey teams.

2.2.4.1 <u>Senior Geophysicist</u>

2.2.4.1.1 Raye Lahti, the Senior Geophysicist, is responsible for all technical matters involving the geophysical tools and techniques that will be implemented on this project. The responsibilities include selecting the proper instrumentation and navigational equipment, designing and implementing a geophysical plan to meet the requirements of the PWS and the project's objectives, and assurance of the overall quality and integrity of the geophysical effort. The Senior Geophysicist will also be responsible for analyzing and directing anomaly selection for removal and DGM QC verification mapping. The Senior Geophysicist will work in close coordination with the MEC Technical Manager and all other geophysical personnel.

2.2.4.2 <u>Other Geophysical Personnel</u>

2.2.4.2.1 The project geophysicists will be responsible for the overall coordination of data acquisition and performing data processing and analysis. Additional responsibilities will include reviewing data, monitoring technical performance of field teams, and coordinating with the field teams in the development of field reports. GIS personnel will be responsible for creating, maintaining, and managing geospatial databases. The geophysical survey teams will coordinate with the project geophysicist and UXO personnel for all field activities. The teams will be responsible for following geophysical standard operating procedures (SOPs), recoding/logging data collection activities, downloading raw data from field computers, and maintaining equipment.

2.2.5 UXO Personnel

2.2.5.1 The UXO project team will consist of the SUXOS, a UXO QC Specialist (UXOQCS), UXO Safety Officer (UXOSO), and UXO technicians. When field personnel on site consist of less than 15 workers, the UXOQCS and UXOSO may be dual-hatted.

2.2.5.1 Senior UXO Supervisor

2.2.5.1.1 Scott Schroepfer, the SUXOS, will be the senior subject matter expert in the field during the execution of the RI field activities. His responsibilities include planning, coordinating, and supervising all on-site MEC-related activities; implementing procedures and guidance for MEC operations; certifying MPPEH and/or range scrap as ready for turn-in or disposal; maintaining project-specific documentation and records; and supervising multiple project teams during the RI that are performing MEC and MEC-related activities. The SUXOS will be responsible for analyzing the sites for risks, hazards, and safety requirements and for ensuring implementation of the approved SSHP for on-site field activities. He will enforce compliance with all site-specific safety requirements including DoD directives and instructions; Army and USACE policy and guidance; and federal, state, and local statutes. The SUXOS will report directly to the PM and the MEC Technical Manager and will have an open line of communication with the UXOSO.

2.2.5.2 UXOQCS

2.2.5.2.1 The UXOQCS is responsible for all on-site quality issues and is the single POC for all MEC quality-related issues. Additional responsibilities of the UXOQCS will include the following:

- Monitoring all activities affecting quality during clearance activities,
- Ensuring that procedures are being implemented in accordance with established requirements and protocols,
- Understanding the project's quality-related requirements and implementing the required plans and procedures to comply with them,
- Performing QC activities, and
- Preparing the Daily Quality Control Report (DQCR).

2.2.5.2.2 The UXOQCS will report directly to the HGL PM and the Deputy PM for project-specific direction and will have a direct line of communication with the Quality Control Manager and open communication with the SUXOS and UXOSO.

2.2.5.3 UXOSO

2.2.5.3.1 The UXOSO is responsible for monitoring all site activities for compliance with plans, procedures, and regulations relative to the health and safety of all employees, project members, land users, residents, and visitors. The UXOSO is additionally responsible for monitoring all MEC investigation, removal, and demolition activities to ensure compliance with health and safety requirements as established in plans and procedures. The UXOSO will report to the PM for project-specific direction, will have a direct line of communication with the Program Health and Safety Manager for administrative and technical direction on health and safety matters, and will have open communication with the SUXOS.

2.2.5.4 UXO Technicians

2.2.5.4.1 UXO technicians will be required to perform anomaly avoidance tasks, instrument-assisted surface reconnaissance, anomaly investigations, and documentation of all required information. UXO personnel will also be responsible for removing and disposing of all MEC and MD found; however, only a UXO Technician II or above can perform anomaly avoidance tasks and instrument-assisted surface reconnaissance.

2.3 PROJECT COMMUNICATIONS AND REPORTING

2.3.1 Communications

2.3.1.1 Communications for this project will generally flow along the lines established by the project organization chart shown on Figure 2.1. Communications between HGL and the USAESCH and or CESAW will primarily be directed through the respective PMs or the CO at USAESCH. Communications directly between HGL and other government entities associated with this project will occur only when directed by USAESCH. All project personnel will meet and talk on a frequent basis via online meetings, emails, and conference calls. Technical personnel are encouraged to work directly with their counterparts to resolve technical issues. Significant conversations, meetings, or other communications will be documented and shared among all team members. On-site activities will be coordinated with Camp Butner communications through use of radios while in the MRS.

2.3.2 Reporting

2.3.2.1 Reporting will comply with the requirements contained in the PWS. Weekly activity reports and monthly status reports will be completed through the duration of the project. Daily activity reports will be submitted to the PM from the SUXOS or his designee.

2.4 DELIVERABLES

2.4.1 Project deliverables will meet the schedule requirements of the project and will be prepared in the format indicated in the PWS. HGL will submit all deliverables to USAESCH and other reviewers IAW Paragraph 2.5.2 of the PWS. Deliverables will receive internal HGL reviews prior to submittal to other organizations. USAESCH and CESAW will review draft documents and provide comments to HGL IAW the project schedule. The draft and draft final versions of this document have been reviewed by USAESCH, CESAW, and NCDENR and their comments have been incorporated. In general, deliverables for USAESCH and CESAW are for acceptance while the deliverables for the NCDENR are for concurrence purposes. The following deliverables are required under the PWS:

- Meeting Minutes from Kickoff Phone Conference
- Proposed Schedule
- Pre-TPP Meeting Materials
- CSM
- Final TPP Memorandum (after First TPP Meeting)
- Draft and Final TPP Memorandum Addendum (after Second TPP Meeting)
- Draft and Final TPP Memorandum Addendum (after Third TPP Meeting)
- Draft, Draft Final, and Final Public Involvement Plan
- Draft and Final Pre-Public Meeting Materials
- Draft, Draft Final, and Final WP/QASP
- Draft, Draft Final, and Final RI Report
- Draft, Draft Final, and Final FS report
- Draft, Draft Final, and Final PP
- PP Meeting Transcripts
- Responsiveness Summary
- Draft, Draft Final, and Final DD
- Final Administrative Record (on CD/DVD)
- Final GIS Files on CD
- QC documents to include the following:
    - DQCR for Environmental Sampling
    - Analytical Data Submittal for QA Evaluation
    - Electronic Laboratory Data Submittal

2.5 PROJECT SCHEDULE

2.5.1 HGL uses Microsoft Project to compile and track scheduled project activities. Figure 2.2 (Appendix B) presents the schedule for the Camp Butner RI/FS project. The HGL PM will monitor and report all tracking information to the USAESCH PM as described in Section 2.4.

2.6 PERIODIC REPORTING

2.6.1 HGL will prepare monthly progress reports, when not actively conducting field operations, IAW DID WERS-016.01, Periodic Status Reports. These will summarize project progress and detail task-specific information associated with the reporting period, clarify status of current work, and state plans for future work. This report also will identify whether the current work is on schedule and, if necessary, describe actions required to return it to schedule.

2.6.2 When actively conducting field operations, HGL will prepare weekly status reports consistent with DID WERS-016.02, Periodic Status Reports, upon the initiation of fieldwork. Weekly reports will be developed and submitted to the USAESCH for the duration of fieldwork.

2.7 COSTING AND BILLING

2.7.1 Costing

2.7.1.1 HGL's project delivery system, DELTEK®, is designed to facilitate control of costs and schedules based on real-time budget, cost, and schedule data. The HGL PM reviews this information on a regular basis to anticipate and prevent cost overruns and schedule delays. By frequently reviewing actual costs and performance progress in comparison with budgets and schedules, potential costs and/or schedule variances can be identified early and corrective action implemented. This reporting is for internal use, and billing is based on completing milestones for the planning and documentation phases of the project. Fieldwork is a mix of firm fixed price and fixed unit price tasks under the TO.

2.7.2 Billing

2.7.2.1 HGL uses the DELTEK® cost accounting system to manage financial information for its clients. Subcontractor invoices and employee work records are input daily to maintain a real-time snapshot of the project's budget. HGL PMs are well versed in the data analysis functions of DELTEK® for management and billing activities.

2.8 PROJECT PUBLIC RELATIONS SUPPORT

2.8.1 HGL will participate in stakeholder meetings to execute the TPP process, five restoration advisory board (RAB) meetings, and two public meetings to discuss project progress and present findings. The HGL project team's participation will include delivery of presentations, plus development and production of TPP worksheets and handout materials including fact sheets for public meetings. HGL will develop a public involvement plan (PIP) that will describe the approach of informing the community about the project and support public meetings as needed.

2.9 SUBCONTRACTOR MANAGEMENT

2.9.1 Proven safety and QA/QC processes and procedures are incorporated and specific deliverables are specified in HGL's relationships with its subcontractors. HGL's Quality Management Program provides for subcontractor site evaluations, supplier ratings, and inspections by HGL, as appropriate. HGL's Quality Management Program also ensures that subcontractors are aware of contract requirements.

2.10 MANAGEMENT OF FIELD OPERATIONS

2.10.1 The HGL PM and SUXOS will oversee all aspects of the field operations. Field staff (including subcontractors) will communicate daily with the HGL SUXOS. The SUXOS will address any unexpected issues or concerns that arise during field operations. Thus, the SUXOS will be aware of any changes in site conditions or planned modifications to field procedures. The HGL PM will involve the USAESCH PM as necessary, but at a minimum will inform her of any changes in site conditions or planned modifications to field procedures for consideration and concurrence by USAESCH.

2.10.2 Mobilization – During the first week of the field effort, HGL will mobilize equipment and personnel to the former Camp Butner. During this period the office trailer, communications, and sanitary facilities will be established. For previous field events at Camp Butner, the Army National Guard has permitted the use of its facility for staging of an office trailer; this facility will be the preferred location for the RI field effort. Also, during field investigation activities, HGL will provide for the use of portable restroom rental units.

2.10.3 Geophysical Surveys – Multiple geophysical teams will conduct surveys of the MRSs within the former Camp Butner IAW the PWS and this WP. At a minimum each team will be composed of one Team Leader (under the direction of the MEC Technical Manager) and one UXO-qualified individual (UXO Technician II or higher). The UXO-qualified individual will provide visual clearance and UXO avoidance for the team as well as assist in the geophysical survey operations.

2.10.4 UXO Sampling and Excavation – Multiple teams will conduct intrusive excavation and sampling of the identified anomalies. Appropriate QC activities will be conducted during and after an intrusive effort.

TABLES

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Table 2.1
Roles and Responsibilities Matrix

Task	CESAW	USAESCH	HGL
1. TPP and Site Visit	Plan and coordinate stakeholder meetings	Review and comment on TPP materials. Participate in TPP meetings.	Participate in TPP-related meetings to define the scope of the project, determine data needs, develop data collection options, and finalize data collection program. Prepare TPP materials including briefings and handouts.
2. PMP/QASP	Review and comment	Review and comment, QA, and approval	Primary author. Specify project approach, project team, quality processes and procedures, and defining the communication processes.
3. RI/FS WP	Review and comment	Review and comment, QA, and approval	Primary author. Specify the processes and procedures to complete the RI.
4. RI Field Activities	Review field data and results and provide comment.	Provide on-site safety specialist, QA, and assist with internal Army notifications in the event a CWM emergency response is necessary.	Conduct field activities including geophysical investigations, intrusive investigations (anomaly interrogation), and proper disposals of any items recovered. Establish and manage data collected.
5. RI Report	Review and comment	Review and comment, QA, and approval	Primary author. Determine the nature and extent of MEC contamination and define the explosive safety hazards for the site with respect to potential MEC and MC.
6. FS Report	Review and comment	Review and comment, QA, and approval	Primary author.
7. PIP	Provide PAO support during interview process and review and comment on PIP.	Review and comment, QA, and approval	Work with CESAW PAO, as necessary, to draft PIP. Define the role and participation of the public.
8. Community Relations Support	Provide PAO and related support for public meetings/public involvement. Coordinate with stakeholders to schedule public meetings.	Review and comment, QA, and approval	Work in concert with CESAW PAO, as necessary; deliver presentations, develop/produce handout materials, attend public meetings.
9. PP	Review and comment, coordinate public meeting as needed.	Review and comment, QA, and approval	Primary author. Coordinate the public comment period for the PP.
10. DD	Review and comment	Review and comment, QA, and approval	Primary author. Document the final decision for the site.
11. Administrative Record	Review and comment	Review and comment, QA, and approval	Update and maintain public record in the information repository related to applicable final project submittals.

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3.0 FIELD INVESTIGATION PLAN

3.0.1 The Field Investigation Plan defines the specific approach, procedures, and rationale proposed for the execution of the RI/FS field activities at the former Camp Butner. This specific plan has been developed to meet the overall objective of this RI/FS, to satisfy the DQOs, and to characterize the nature and extent of MEC (either UXO or DMM) and MC IAW the agreed upon requirements developed during the TPP.

3.0.2 A combination of geophysical transect and grid investigations using DGM methods and techniques will be utilized to identify the nature, estimated quantity, and areal and vertical extent of MEC. Intrusive investigation of geophysical anomalies will be conducted to evaluate the type and depth of MEC present. Sampling of site-specific media will be conducted to determine the nature and extent of MC present and data collected during the current and previous completed investigations and removal actions (RAs) will be incorporated into the project dataset and GIS systems to document and archive project data. The plan also specifies the selected approach to perform an ecological and human health risk assessment (HHRA) for the purpose of developing and evaluating effective MC remedial alternatives.

3.0.3 The goal of the RI is to conduct an on-site investigation of each of the three MRSs to gather sufficient data to characterize the nature and extent of MEC (either UXO or DMM) and MC contamination. The data obtained during the RI will be used during the FS to present and evaluate viable remedial alternatives for the contamination identified during the site characterization effort. The overall RI approach includes the following:

- Compiling existing information and data associated with previous investigations, RAs, and reports;
- Identifying data needs and developing DQOs through the TPP;
- Defining the technical approach and procedures for execution of the RI;
- Performing geophysical investigations to delineate the potential extent of MEC contamination to include
    - Site preparation,
    - Geophysical system verification (GSV) using an instrument verification strip (IVS) and blind seeding,
    - Instrument-assisted reconnaissance surveys along parallel transects,
    - Intrusively investigate a suspect 37mm projectile anomaly detected during the ESTCP Pilot Study,
    - DGM surveys along parallel transects,
    - DGM grid surveys in areas of high, medium, and low anomaly count densities,
    - Anomaly identification, investigation, and characterization within the grids to evaluate the types and depths of MEC present,

  - Disposal of MEC/material potentially presenting an explosive hazard (MPPEH) and processing and disposition of munitions debris (MD)/range related debris (RRD)/cultural debris (CD), and
  - Site restoration activities such as backfilling and leveling.
- Completing MRS-specific sampling and analysis to characterize MC concentrations present in site-specific media (surface and subsurface soil, sediment, and groundwater, as site-specific conditions dictate);
- Conducting an HHRA and an ecological risk assessment (ERA) to evaluate potential risk associated with MC present and evaluating explosive safety hazards for MEC;
- Documenting investigation activities and results through the TPP process during the RI to identify data gaps, scheduling issues, and/or to gain stakeholder concurrence;
- Establishing, updating, and maintaining a project GIS database;
- Updating of the CSM and MRSPP; and
- Submitting the RI report.

3.0.4 The geophysical transect survey data will be used to generate initial anomaly concentration figures. Following completion of the transect survey, geophysical grid locations will be selected based on transect anomaly concentrations, field observations and historical data. Supplemental field activities conducted in conjunction with the geophysical grid survey will include establishing survey control; reacquiring geophysical anomalies identified during the DGM effort (within grids); and identifying, removing, and disposing of MEC, CD, and MD-related scrap. Data and information obtained during the completion of the intrusive investigations will be used to identify biased sampling locations. While DGM is preferred, areas that are not suitable for DGM will be characterized using analog geophysical mapping (AGM) techniques.

3.0.5 Site preparation, reconnaissance, AGM and DGM surveys, media sampling, intrusive investigations, and MEC disposal will be performed by HGL. Geophysical DGM surveys will also be conducted by AMEC, a contract team partner. For consistency, AMEC will process all DGM data. HGL will provide project oversight and process and product quality management for the geophysical investigations. Other subcontractors providing services to HGL in support of the Camp Butner RI activities will include two analytical laboratories (Microbac and Accutest, both of which are DoD Environmental Laboratory Accreditation Program [ELAP]-certified laboratories).

3.0.6 Section 3.1 summarizes the RI investigation technical approach. Sections 3.2 and 3.3 detail the specific approaches and rationale to be used during the geophysical and MC sampling phases of the RI. Sections 3.4 and 3.5 summarize TPP and DQO objectives. Appendix H specifies the results of the TPP meeting and identifies DQOs defined during the process. Sections 3.6 through 3.13 specify the techniques and procedures necessary to execute the field activities. Sections 3.14 through 3.16 summarize the approach that will be used during the RI to conduct the HHRA and ERA. RI field activities will be performed IAW the requirements in the APP (Appendix D) and the Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP) (Appendix E).

3.1 TECHNICAL APPROACH

3.1.1 The technical approach was developed by HGL to characterize the nature and extent of MEC (either UXO or DMM) and MC at the five MRSs using available site information, including the ASR, EE/CA, and RA reports and other pertinent documents. The technical approach was briefed during the TPP meeting and has been utilized in the development of this site-specific RI WP. As discussed during TPP meetings, HGL will solicit project team concurrence and input during evaluation of the RI data collected for characterization of MEC (whether UXO or DMM) and MC.

3.1.2 As previously indicated, the status of FTR and HGR MRSs was discussed during the TPP process, and results of those discussions indicate that previous RAs and EE/CAs provided data adequate to meet the objectives of this RI/FS. Therefore, no additional fieldwork is planned for this RI.

3.1.3 The technical approach for RC1, RC2, and the ARNG sites is based upon the history of the sites in terms of munitions usage and past clearance activities and RAs. During Camp Butner training activities, various types of munitions were utilized. Munitions deployed at Camp Butner included small arms; hand grenades; rifle grenades; practice landmines; 20mm through 240mm projectiles; 60mm and 81mm mortars; and 2.36-inch rockets. During the completion of previous investigations, numerous areas were investigated and/or cleared. Using the existing EE/CA and RA data, the nature and extent of MEC has been characterized for significant portions of RC1 and RC2. However, EE/CA and RA coverage was generally limited to low-density residential dwellings, typically along main roadways; therefore, significant expanses of RC1 and RC2 have not been investigated or characterized. Furthermore, no characterization activities have been conducted on the ARNG property.

3.1.4 Utilizing data presented in the ASR, information produced during EE/CA field activities, and the GIS-based aerial photograph analysis (TEC, 2001), HGL developed boundaries for interpreted impact areas. Sections 3.2 and 3.3 summarize the technical approach for geophysical and munitions constituent characterization of the areas inside and outside the interpreted impact area boundaries. Table 3.1 identifies the technical approach at each of the three MRSs and provides the rationale for the former Camp Butner RI field activities.

3.1.5 An anomaly was identified during the ESTCP Pilot Study that is suspected to be a 37mm projectile. The anomaly will be intrusively investigated and source resolved. The ESTCP Pilot Study predicted a fragment at 10 cm depth and a 37mm at 20 cm depth. Intrusive investigations recovered fragments at a depth of 12 cm, but may not have investigated deeper. HGL will relocate the anomalies coordinates, then reaquire and intrusively investigate the anomaly. The anomaly's coordinates are: 699,373.92 E, 4,015,696.08 N in UTM meters.

3.2 GEOPHYSICAL SURVEY AND ANOMALY INVESTIGATION

3.2.1 A combination of reconnaissance, DGM and AGM techniques, equipment, and methods will be used to conduct geophysical surveys and assess the nature and extent of MEC during the completion of the RI activities at former Camp Butner. In general, DGM transects and grids will be used to identify potential surface and subsurface anomalies/MEC associated with former activities at each MRS. Geophysical results will also be used to determine the distribution, density, and extent of MEC, if present. Areas inaccessible for DGM surveys, due to steep or rough terrain, will be surveyed using AGM methods to verify the presence or absence of MEC/MD. The geophysical site characterization approach utilizing DGM and AGM is summarized in Table 3.2.

3.2.1 Geophysical Investigation Approach for Interpreted Impact Areas (Areas Expected to Contain MEC)

3.2.1.1 The investigation strategy proposed for each of these areas is similar: (1) DGM characterization along transects that vary in spacing; and (2) placement of grids in areas of high, medium, and low anomaly density. Grids will be placed in each area, and each grid will be evaluated with DGM and intrusive investigation of anomalies selected (see Section 3.2.1.7). Grid location selection will be based on DGM transect anomaly concentrations, the findings of the GIS-based aerial photograph analysis (TEC, 2001), and past investigations. Figures 3.1 through 3.3 show the planned DGM survey transects for each of these MRSs.

3.2.1.2 It is expected that ROEs will not be granted for all land parcels present within these MRSs; therefore, investigation activities will be limited to areas where ROEs have been granted by landowners. These areas will be identified on the geophysical maps prepared following the survey.

3.2.1.3 Proposed geophysical transect spacing is based on munitions used and findings from previous site characterizations/RAs. Anomaly density maps will be developed following transect investigations to place grids at high, medium, and low anomaly density locations. DGM and intrusive investigations within these grids will refine our understanding of the distribution, quantities, and types of MEC present. In the event that MEC is discovered at the outer boundary of an MRS, the project delivery team (PDT) will be consulted to determine an acceptable approach for expanding the characterization.

3.2.1.4 HGL’s efforts will focus on the interpreted impact areas (areas within each MRS expected to contain MEC contamination). HGL will traverse areas using geophysical techniques and equipment to characterize transects in areas expected to contain MEC. HGL’s objective is to delineate with 90 percent confidence areas previously utilized or impacted by MEC. Confidence will be established using a combination of Visual Sampling Plan (VSP) and UXO Estimator.

3.2.1.5 HGL will determine the grid areas to be surveyed in close coordination with the Army and other stakeholders. The DGM survey will be conducted by a two-person team consisting of a geophysicist and a UXO technician (Level II or above) for support and avoidance purposes. The team will coordinate closely with the landowners to access their property.

3.2.1.6 The HGL team will conduct the DGM surveys using a Geonics, Ltd., EM61-MK2 metal detector and one or more of the following Global Positioning System (GPS) methods: wide area augmentation system (WAAS), post-process kinematic (PPK), or real-time kinematic (RTK).

3.2.1.7 The HGL team will process the digital geophysical transect data to produce a map showing the elevated anomaly areas that will be used for selection of DGM grid locations. The HGL team will process the digital geophysical grid data to produce maps showing the distribution and magnitude of identified anomalies. DGM grid data will be processed and analyzed to identify targets or anomalies that most likely represent MEC or MPPEH. Because the area includes former ranges, the potential exists for a large amount of debris to be present on site. Anomalies may be ranked or prioritized based upon their characteristics and likelihood of being MEC. A target list will be developed from this data that will be intrusively investigated by HGL to determine the nature of the selected target anomalies. HGL will develop the selection criteria using an iterative approach during the evaluation of the geophysical data collected. The evaluation will involve analysis of data collected during the GSV process and the DGM survey data to identify appropriate parameters. The project team (including USACE geophysicist) will be involved in and concur with the evaluation of background anomaly densities and selection of areas of high, medium, or low anomaly density. Section 3.6 of this WP and HGL's SOP 6.01.01, *Digital Geophysical Mapping Using Geonics, Ltd., EM61-MK2* (Appendix I), presents specific field procedures and techniques that will be utilized to conduct the DGM geophysical survey.

3.2.1.8 Performance metrics for the DGM surveys are provided in Table 3.3. The DGM data will be reviewed and inspected daily to ensure compliance with the performance metrics and the data quality metrics presented in Section 4.0 of this WP. Performance and data quality metrics provide a quantifiable measure of the quality of the data collected by documenting the response of the DGM system under both test and field production conditions. If any technical issues are found with the data (such as, excessive coverage gaps), the affected area may be resurveyed or additional coverage may be obtained to ensure that the DGM survey meets the project objectives.

3.2.2 Geophysical Investigation Approach for Areas Outside Interpreted Impact Areas (Areas Not Expected to Contain MEC)

3.2.2.1 The investigation strategy proposed for each of these areas is similar: (1) instrument-assisted reconnaissance surveys along parallel transects at 500-foot spacing, and (2) placement of grids in historical use areas outside of the interpreted impact area. Each grid will be evaluated with DGM and intrusive investigation of MEC-like anomalies. Figures 3.1 through 3.3 show the planned reconnaissance transects for each of these MRSs.

3.2.3 DGM Mapping Basis and Coverage

3.2.3.1 <u>Historical Use Transect Bias</u>

3.2.3.1.1 Historical information was used to outline potential MEC use areas. Specifically, this method allows the project team to identify target areas and other areas of high anomaly density. The transect spacing (sampling density) for each area is based on the activity that reportedly took place within the respective area and/or munitions items recovered during previous investigations and RAs. Factors such as historical range use, ordnance type, and range size are incorporated into the strategy to determine probable target size.

3.2.3.2 <u>Historical Use, Transect Data, and Grid Bias</u>

3.2.3.2.1 Grid locations and size (nominally 2,500 $feet^2$) will be distributed throughout the area based on transect data to define the areal distribution and type of MEC present. The grids will be of various shapes and sizes depending on the anomaly density of the "target" areas. These grids will be mapped using DGM to identify potential MEC items. Targets identified within the grids will be intrusively investigated by UXO-qualified technicians. All MEC-like anomalies and 10 percent of the residual anomalies (non MEC-like) will be investigated within each grid to adequately characterize anomaly sources within the grid.

3.2.3.3 Non-Biased Surface Reconnaissance

3.2.3.3.1 The field teams will perform instrument-assisted surface reconnaissance using Schonstedt magnetometers (or equivalent) coupled with WAAS or PPK GPS within areas less likely to contain munitions. Transects will be spaced at 500 feet as illustrated in Figures 3.1 through 3.3. Anomaly count data and MEC-related items found on the surface will be recorded and used to generate anomaly distribution density maps. Based on the findings of the reconnaissance and discussions with the PDT, additional characterization (DGM transects and/or DGM and intrusive investigation of grids) may be required to verify the extent of residual MEC.

3.2.3.3.2 In the event that MEC related items are discovered at the outer boundary of the MRS, field personnel will coordinate with the PDT to determine an acceptable approach for expanding the characterization of the affected MRS. Using the grid and transect data, the interpolation of MEC extent (boundary) will be on the order of several meters.

3.3 MUNITIONS CONSTITUENTS INVESTIGATION APPROACH

3.3.1 To determine if MC contamination is present in concentrations greater than the screening levels, soil samples will be collected at biased locations (i.e., target areas and firing points) for laboratory analysis. Analytes will include explosives and selected MC metals (copper, lead, antimony, and zinc). The results of the geophysical mapping, intrusive investigations, multimedia sampling, and data collected during the previously completed investigations and RAs will collectively be used to define the nature and extent of MEC present and/or MC contamination.

3.3.2 Based on existing site conditions, historical site activities, and previous investigation data and results, HGL has determined that an ISM sampling strategy is appropriate for use for the characterization of MC during the RI at former Camp Butner. The ISM sampling strategy will be used in conjunction with discrete sampling to characterize MC. Discrete subsurface samples may be collected to further investigate the ISM results obtained for surface soil. A summary of the MC sampling strategy to be used at each of the MRSs is presented in Table 3.1. Additional details associated with the execution of the MC sampling approach are presented below.

3.3.3 ISM Sampling Approach

3.3.3.1 During the RI, HGL will incorporate ISM to conduct soil characterization sampling at sampling units (SUs) identified during the completion of the DGM geophysical survey and intrusive activities. HGL is using the ISM sample collection and processing methodology because the process incorporates specific elements designed to control data variability due to heterogeneity in contaminant distribution. The objective is to obtain a single sample that contains all analytes in exactly the same proportion as in the entire sampled area. This is achieved by collecting a sufficient number of discrete “increments” (typically 30 to 100) in an unbiased manner from throughout a specified area (the SU), combining and processing the increments, and incrementally sub-sampling the processed material to obtain a representative aliquot for analysis. Properly executed, the method provides unbiased, representative, and reproducible estimates of the mean concentration of analytes in the SU.

3.3.3.2 During the RI field activities at Camp Butner, 32 incremental soil samples will be collected for explosives and metals constituents from the SUs (100 by 100 foot grids) using the methodology outlined in Appendix A of EPA Method 8330B and Interim Guidance Document (IGD) 09-02 (USACE, 2009b). The SU size is appropriate because the data obtained is a reasonable residential lot size for comparison to risk-based soil screening levels (See Section 3.15.1.6) and is relevant to the CSM developed for Camp Butner (Figures 3.4 and 3.5). Additionally, the number of increments (see Section 3.11.1.5.1) planned is expected to provide spatial density sufficient to control variability due to the non-uniform distribution of contaminants within the SU, but still be practical for logistical considerations. An environmental scientist and a UXO-qualified technician (to provide escort) will collect soil samples for chemical analysis. In addition, the sampling team will collect QC (e.g., field triplicates) and QA samples. Analytical sampling is covered in greater detail in Appendix E.

3.3.3.3 The USACE TPP guidance (USACE, 1998) and guidance provided by the *Implementation of Incremental Sampling (IS) of Soil for the Military Munitions Response Program* (USACE, 2009b) describe a process for systematic planning, which determines the sampling objectives, sampling strategy, and sampling design that govern how the IS methodology will be adapted and applied. Appendix H summarizes factors considered during the TPP. A summary of the ISM sampling approach and rationale is provided in Table 3.1.

3.3.4 Discrete Soil and Sediment Sampling Approach

3.3.4.1 If, based on the ISM sample results, constituent concentrations are detected that exceed relevant criteria, as specified by the TPP, then a combination of additional ISM samples and supplemental discrete sampling will be conducted to confirm the presence of the elevated concentrations and evaluate potential source areas. If this is required, additional surface soil ISM locations and discrete shallow subsurface (0.5 to 2.0 feet bgs) soil samples will be collected at locations selected by the PDT.

3.3.4.2 In addition, if ISM sample results indicate that detected constituent concentrations exceed relevant criteria and determine that these potential source areas may impact adjacent surface water bodies, then, in consultation with the PDT, HGL will collect supplemental sediment samples from PDT-identified locations to determine if these source areas have impacted sediments in adjacent surface water bodies.

3.3.5 Background ISM Sampling Approach

3.3.5.1 Background soil samples comprising a minimum of 10 ISM SUs will be collected from areas similar to but outside MRS boundaries per EPA guidance. Background soil samples will be analyzed for select metals using Method 6020A. The analytical methods and analyses are presented in Figure 3.1. A sample matrix outlining the total samples proposed for collection is presented in Table 3.4.

3.3.5.2 All hand augers, spoons, trowels, sample coring devices, and other reusable sampling equipment used to collect surface and subsurface soil samples will be decontaminated between each sampling location by using a multistep decontamination process. ISM samples will be collected in accordance with applicable guidance (see Section 3.3.3).

3.3.6 Sediment Sampling

3.3.6.1 Based on PDT input, 10 sediment sample locations may be selected within each MRS. Sediment samples may be collected to evaluate the potential impact of MC (explosives and selected metals [lead, copper, antimony, and zinc]) on local surface water bodies. If sample collection occurs, samples will be collected as specified in Table 3.4.

3.3.7 Groundwater Sampling

3.3.7.1 Groundwater sampling may be conducted at 10 PDT selected production\drinking water wells to determine if past perchlorate and lead detections are attributable to sources other than MC and to confirm previous investigation results. If groundwater samples are collected, background groundwater samples and QC and QA groundwater samples will also be collected and analyzed as specified in Table 3.4.

3.4 TECHNICAL PROJECT PLANNING

3.4.1 The TPP process has been used to gain consensus on the RI technical approach. TPP meetings provide the opportunity for project stakeholders to discuss and finalize technical details associated with the design and execution of the RI. A detailed summary of the TPP meetings is provided in Appendix H.

3.5 DATA QUALITY OBJECTIVES

3.5.1 To generate data that will meet the project objectives, it is necessary to define the types of decisions that will be made, identify the intended use of the data, and design the requisite data collection program in an effort to characterize the residual hazards/risk remaining at the project site. DQOs are statements defining the quality, quantity, and type of data required (e.g., geophysical), the manner in which data may be collected, and the acceptance criteria for those data, to provide an adequate database to support project decisions. DQO worksheets addressed during the TPP meeting and DQOs established during the TPP process are listed in Appendix H. As a summary of the DQO development conducted during the TPP process and to present the site-specific DQO statements developed for the site, Table 3.7 provides an overview of the DQOs. Table 3.7 also provides a cross walk for each DQO to the development steps from both the USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* EPA QA/G-4, EPA/240/B-06/001, February 2006, and USACE *Technical Project Planning Process*, EM 200-1-2, 31 August 98. The data collected under the DQOs summarized in Table 3.7 will be continuously evaluated against the appropriate decision rule. The anticipated decision rules are included in Table 3.8. HGL will solicit project team concurrence and input during evaluation of the RI data collected against the project DQOs and decision rules.

3.6 GEOPHYSICAL INVESTIGATION

3.6.1 Geophysical techniques provide physical methods of characterizing subsurface features. In particular, reconnaissance and DGM techniques can provide nonintrusive evaluation of the subsurface where little information currently exists. Section 3.6 specifies procedures, equipment, and techniques that will be incorporated during the geophysical investigation of the MRS areas during the former Camp Butner RI.

3.6.1 Site Preparation Procedures

3.6.1.1 Prior to conducting any site activities, MEC/MPPEH avoidance procedures will be utilized to identify potential surface hazards. The ground surface and aboveground locations that might normally conceal MEC or MD will be visually inspected by a qualified UXO technician. For example, ordnance is occasionally discovered embedded in trees above eye level where the tree has grown in the years following the impact. If possible, any surface metallic debris encountered will be removed from the pending survey area; otherwise, these targets will be clearly marked with flagging. The location of these target items subsequently will be mapped with a GPS unit. These data will be incorporated into the processed geophysical data to enhance the data interpretation.

3.6.1.2 HGL SOP 15.2, Anomaly Avoidance Support, provided in Appendix I, specifies MEC and MPPEH anomaly avoidance procedures that will be used during the completion of the site preparation activities.

3.6.1.1 Support Facilities

3.6.1.1.1 A field office will be established within a centrally located area; an Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF)-approved magazine will be sited IAW the approved Explosives Site Plan (ESP) for storage of donor explosives.

3.6.1.2 Location Surveys

3.6.1.2.1 PPK and WAAS-capable handheld GPS units will be used to identify boundaries and record the track of the survey, respectively. The boundaries of the geophysical survey grids will be marked with nonmetallic stakes. Before implanting these stakes, an avoidance survey will be performed using a handheld Schonstedt fluxgate gradiometer to verify that the subsurface is free of metallic debris and potential MEC/MD at that location. Coordinates of staked locations will be recorded using a GPS. These locations will serve as reference points for the DGM and target reacquisition. Additional survey control points will be established across the MRS as necessary.

3.6.1.2.2 The GPS coordinates of the grids and transects will be loaded into a handheld GPS unit so that they can be plotted and flagged by the field crew during field operation activities. Applicable locations will be marked using wooden boundary marker stakes placed during the site and boundary identification phase described above. If surface evidence of MEC is discovered during site preparation activities near the MRS investigation boundary, HGL will consult with the PDT to discuss expanding the investigation boundary.

3.6.1.3 Vegetation Removal

3.6.1.3.1 HGL team will clear undergrowth in transects and grids that will be investigated during the RI, and will leave flagging and survey stakes to mark transect paths in areas where GPS cannot be used. MEC/MPPEH avoidance procedures will be utilized to identify potential surface hazards as described in Section 3.6.1.1 and 3.6.1.2.

3.6.1.3.2 The project team recognizes that property owners may have concerns that transect paths cut through wooded areas may promote trespassing. When transect pathway clearance is required, pathways will be limited to a nominal width of 4 to 6 feet. Brush clearing will be accomplished by a two-man brush clearing team consisting of a UXO Technician II and a heavy equipment operator using a tracked loader with mulching head or brush-hog attachment. Brush clearing personnel will wear appropriate personal protective equipment (PPE). Areas with heavy vegetation will be avoided, where possible, to maximize the amount of area to be surveyed.

3.6.1.3.3 During brush clearing, any discovered surface MEC related items will be documented for inclusion in the RI.

3.6.2 Investigation Equipment

3.6.3.1 Section 3.6.2 identifies geophysical and navigational/positioning equipment that will be used to execute the RI field activities.

3.6.2.1 DGM and AGM Equipment

3.6.2.1.1 The DGM team will use a Geonics, Ltd., EM61-MK2, which is a highly sensitive electromagnetic metal detector consisting of coincident transmitter and receiver loops, in a 1- by 0.5-meter rectangular configuration. The EM61-MK2 nominally transmits at 75 to 150 hertz (Hz). The DGM survey will record geophysical response amplitude at four time gates along the (electromagnetic) signal decay curve. Data will be acquired and recorded using an Allegro CX, or comparable field computer. The Allegro CX supports real-time graphic display of data for review and QC, data storage via flash card for extended survey time, and serial port input connections for simultaneous collection of both electromagnetic and GPS data.

3.6.2.1.2 Data will be collected at a sampling rate of 10 Hz. Walking at a comfortable, sustainable rate of 2.5 meters per second or less will achieve the desired sampling control. Geophysical response and position will be simultaneously recorded in a data logger. A lane spacing of 0.8 meter is planned for the DGM survey of the contiguous coverage areas; transect spacing will be variable as needed to navigate around obstacles.

3.6.2.1.3 During the execution of the RI field activities, various instruments may be used to identify surface and subsurface anomalies. Currently, HGL is planning to use the following instruments:

- **White's All Metals Detector:** The White PI SurfMaster or XLT are transient EM metal detectors that offers detection of all metals to depths of approximately 1 foot (0.3 meters).

The systems are handheld, readily portable, and have been used for numerous MEC projects to aid in the detection of near-surface metallic objects.

- **Schonstedt GA-52cx Magnetic Locator:** Magnetic locators may be used to augment personnel safety during anomaly avoidance activities and the intrusive investigation of anomalies; the instrument is more amenable than an electromagnetic sensor to below surface grade tests as an excavation is advanced. The purpose is to help the technicians recognize proximity to an anomaly source as they are digging. The Schonstedt GA-52cx is a handheld magnetic locator consisting of two fluxgate sensors aligned and mounted apart at a fixed distance. When the instrument is passed near ferrous objects, the difference in magnetic flux between the two sensors is registered as changes in an audible tone.
- **EM61-MK2:** The EM61 is a time-domain metal detector that detects both ferrous and nonferrous metals. This time-domain electromagnetic survey transmits a high frequency electromagnetic pulse. This pulse creates electric currents in the subsurface, and these currents are of greater magnitude and last longer in the subsurface in metallic objects than in nonmetallic objects. After the illuminating current is switched off, a measurement of the time-decaying remnant electromagnetic field is recorded at multiple times along the decay curve. The magnitude of the remnant electromagnetic field provides a measurement of the metallic presence in the subsurface.

3.6.2.2 Navigation and Positioning Equipment

3.6.2.2.1 Navigation and positional control will be obtained using a combination of WAAS and PPK GPS and line-and-fiducial methods. Data will be projected in the local Universal Transverse Mercator (UTM) coordinate system.

- **WAAS GPS:** WAAS GPS is capable of 10-meter accuracy and works well under canopy cover. The advantage of a WAAS system over other GPS systems is that it will maintain a greater number of satellite connections over other GPS systems because of the lower accuracy requirement. The GPS antenna will be mounted on the cart in a position where it does not adversely affect the electromagnetic measurements, and the data are streamed directly into the data logger used to capture the geophysical data.
- **PPK GPS:** A PPK GPS system (for example, a Trimble XH GPS system or equivalent) has an advantage over RTK GPS in wooded areas because a radio link is not required between the base station GPS unit and the rover GPS unit, and only four GPS satellites are required to obtain a solution. The accuracy of the GPS positioning of the transect segments may be limited by the brush and tree cover. The GPS antenna will be mounted on the cart in a position where it does not adversely affect the electromagnetic measurements, and the data are streamed directly into the data logger used to capture the geophysical data.
- **RTK GPS (optional):** An RTK GPS system (for example, a Trimble 5700 base station and rover) consists of two dual-frequency geodetic quality receivers that are in radio communication with each other. The GPS antenna will be mounted on the cart in a position where it does not adversely affect the electromagnetic measurements, and the data will be streamed directly into the data logger used to capture the geophysical data.

- **Line-and-Fiducial Positioning:** This method creates a local grid, delineated and marked using calibrated survey tapes, to establish line (lane) separations. Survey tapes can also be used to mark points on the ground electronically flagged in the data logger as the geophysical system passes. If the survey area ground surface is sufficiently smooth, such as to enable continuous contact with a wheeled cart, an encoder incorporated into the DGM system may be used to trigger geophysical measurements at regular intervals along the transect traverse, which are recorded as station intervals along a survey line.

3.6.3 DGM Procedures

3.6.3.1 The DGM survey phase of the Camp Butner RI activities consists of GSV processes and procedures, field data collection (transects and grids), data processing (including data standards), anomaly selection, dig sheet development, and data QC review. Data will be collected for both the GSV and field survey using the same procedures, configurations, and parameters. All data collection and QC tests will be IAW the HGL SOP for DGM surveying with a Geonics, Ltd., EM61-MK2 (Appendix I).

3.6.3.2 The GSV process will be implemented as described in the Strategic Environmental Research and Development Program (SERDP)/Environmental Security Technology Certification Program (ESTCP) document entitled *Final Report, Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Responses* (July 2009), using an IVS to verify appropriate system response and establish baseline noise levels. DGM data will be collected over industry standard objects (ISOs) (e.g., pipe nipples) along both an optimal and a "worst-case" orientation, which will provide an assessment of the detection capabilities and limitations of the EM61 response parameters. The HGL team geophysicists assisted by a UXO technician will install a GSV area/test strip within a clean (i.e., anomaly free) area prior to the commencement of DGM surveying.

3.6.3.3 An IVS test bed will be used daily to verify system response and to monitor system "noise" during the completion of the geophysical survey activities. Failure of the sensor to detect all objects will result in a 100 percent reinspection of known "seed" items, which will be buried at different depths within the plot. The test strip will consist of three or more contiguous parallel transects approximately 35 to 40 meters in length. ISOs will be set along one line, with the principal axis horizontal and normal to the direction of the traverse. For the initial GSV evaluation each transect will be traversed in the opposite direction to the first pass over it, resulting in six mapped traverses. The collected data will be used to generate profiles along each transect to demonstrate the effective performance of the deployed system(s) and to characterize ambient background. From these data, the system detection capabilities and limitations will be derived.

3.6.3.4 The value of an IVS, rather than of a geophysical prove-out (GPO) plot, is that the multiple site-specific ordnance types at multiple depths and orientations typically incorporated into the GPO can be replaced with just a couple of "ISOs" oriented in the least favorable geometry for illumination of the target by the EM61-MK2 transmitter. If the GSV calculator accurately predicts the response to an object with minimal signal coupling (minimal signal illumination results in generation of minimal eddy currents in the target, hence a minimized signal), then the equipment is working as predicted and expected. Furthermore, the predicted response amplitudes for the specific munitions of concern will be representative of the geophysical response amplitudes obtained when illuminated by the EM61-MK2 transmitter signal in the field.

3.6.3.5 Evaluation of the predicted response versus the ambient background of the particular site provides the relevant detection parameters (the response amplitude to be expected in all four channels at known distances beneath the transmitter). This in turn provides the information needed to determine the maximum depth at which the minimal response will be recognized above some site-specific detection amplitude floor (threshold). Use of the IVS and GSV calculator obviate the need for multiple targets, in multiple orientations, at multiple depths. The response curves and data that these parameters sought to capture can be readily extracted using the calculator and GSV protocols.

3.6.3.6 <u>IVS</u>

3.6.3.6.1 The IVS will comprise a target transect approximately 40 meters in length seeded with six standardized metal target simulator ISOs. Three each of two different-sized ISOs cylinders ("small" [having a 1-inch inside diameter (ID) and being 4 inches long] and "medium" [having a 2-inch ID and being 8 inches long]) will be buried at different depths along the target transect. The seed items will be pipe nipples threaded on both ends and made from black welded steel. These standard items are readily available in plumbing and gas supply houses, and in some home improvement or hardware stores.

3.6.3.6.2 Placement of one each of the two different sized ISOs with the top of the target at 0.0 meters bgs, with additional targets set at 0.1 meter and 0.2 meter bgs (for the small ISOs), and 0.2 meter and 0.4 meter bgs (for medium ISOs). Table 3.3 reiterates the IVS survey geometry and provides the predicted response in millivolts (mV) above background for the six seed items. Three data points for each size target allows an empirical response curve to be drawn for each ISO. This is not strictly necessary within the precepts of the GSV protocol, but it provides a site-specific check of the GSV calculator-predicted response and depths of detection. Following the guidance provided by the GSV report, the greatest depth of burial for each item will be selected to ensure that a sufficient signal-to-noise ratio is obtained. ISO separation will be such that discrete anomalies are identified. Each item will be buried with its long axis horizontal in space and parallel to transect direction. The response to the ISO targets should be observed in the data at amplitudes consistent with the physics-based calculated response predicted for the target type and distance beneath the receiver coil (standoff height plus depth of burial).

3.6.3.6.3 For the GSV evaluation four additional parallel transects will be established to (1) record an intermediate geometry response (offset 0.4 meter), (2) document the response of ISOs under the outside edges of the EM61-MK2 (offset 0.5 meter), (3) assess off-line signal falloff (offset 0.7 meter), and (4) record and monitor the instrument noise regime of the deployed system (transect offset 2 meters).

3.6.3.6.4 The static response to each seed will be recorded by positioning the EM61-MK2 directly over the target at ground level (prior to burial) and capturing 15 to 20 seconds of data. An additional 15 to 20 seconds of background data will be collected at the marked target burial location by removing the target without disturbing the position of the EM61-MK2 equipment. Residual static response must be ≥ response predicted from the GSV calculator. This allows a direct comparison between the predicted response provided by the GSV calculator and the

instrument responses captured in the field. These and dynamic geophysical response data collected over each transect and processed following the protocols and criteria provided in the project geophysical quality performance metrics, as well as HGL's SOP 6.01 for DGM surveying with EM61-MK2 equipment (see Appendix I), will be used to document expected DGM performance. The minimum expected response to be used for repeatability tests will be based on the response results obtained over the offset lines. These data will be used to establish the detection performance basis for evaluating the capabilities and limitations of the geophysical data collected for geophysical mapping surveys. The IVS provides a consistent, repeatable evaluation of equipment performance under the specific site conditions extent for a particular project.
3.6.3.6.5 GPS coordinates (± 10 centimeter accuracy) for the end points of each transect, which will be fixed with steel spikes as fiducial markers, will be captured and recorded in the daily log. Prior to burying standard objects, geophysical data will be collected over each transect with each geophysical system to be used on the project, using SOPs. These data preserve the background characteristics and signature for the IVS. Once the background has been recorded and mapped, the survey lanes will be seeded, as described above. The location, depth, and orientation for each seed item will be recorded in the geophysical daily log.

3.6.3.6.6 Geophysical QC will include daily static and dynamic positioning and response repeatability tests, as well as noise tests for vibration, environmental sources, or connectivity. The IVS test bed will be surveyed at least twice daily, after the system is powered on for data collection and before it is powered off. The multiple surveys of the IVS will be compared to the baseline data runs, providing a retrievable depiction of continuing performance and the means to monitor changes, if any, in the recorded noise regime for the deployed equipment. The noise regime, in turn, will provide a measure of a site-specific detection threshold and the ratio of the target response to ambient background. This provides for ongoing monitoring of the production work and preserves a record of both the response to targets and the noise regime of the geophysical systems deployed.

3.6.3.7 Blind Seeding

3.6.3.7.1 As part of the GSV process, blind seeds will be placed by the project UXOQCS at randomized locations within the DGM grid areas to verify performance of the DGM and subsurface anomaly investigations. For geophysical survey grids, the seed items will be emplaced at a variable rate of 1 to 2 per grid. QC seeding provides verifiable target detection and positioning over the course of the DGM survey, as well as a tool for evaluating the data collection, processing, and anomaly picking procedures and intrusive investigation performance criteria.

3.6.3.7.2 The seeds items will be 1.5-inch-ID by 3-inch-long welded steel pipe nipples (nominally the dimensions of a 40mm grenade). QC seed items will be buried using MEC anomaly avoidance techniques within the top 8 inches of soil. All seeds will be buried with the long axis of the cylinder vertical with the top flush with the ground surface). The QC seed identification number will be recorded along with the coordinate location of each seed as they are planted. Coordinates for each placed seed will be captured using a PPK GPS or will be measured in local coordinates from the grid's southwest corner. The DGM survey team will not have prior knowledge of seed placement locations.

3.6.3.8 GSV Evaluation

3.6.3.8.1 The results of the initial GSV data collection will be processed and evaluated to verify equipment performance. The project geophysicist will prepare a letter report presenting the details of the IVS and the DGM survey data. This will be provided to the PM and the QA team. The letter report will be delivered no later than the day after the initial GSV IVS tests are completed. The letter report will include the following:

- As-built drawing of the IVS, including depth and ISO seed orientation;
- Photographs of the seed items, in situ;
- Data profiles for each transect (target, 0.5-meter offset line, and noise lane);
- Tabulated static and dynamic target responses, as well as the 0.4-meter, 0.5-meter, and 0.7-meter offset responses;
- Variation from predicted response; and
- Discussion of the predicted and measured field results, including predicted depth response curves for 40mm and 75mm projectiles.

3.6.3.8.2 DGM survey activities for the MRS transects will not start until the GSV results are reviewed and the notice to proceed has been received from the project geophysicist and SUXOS.

3.6.3.9 DGM and Reconnaissance Transects

3.6.3.9.1 DGM transects will be conducted with the EM61-MK2 sufficiently to characterize MEC distribution in the MRSs. Transects within the MRS will be surveyed using WAAS-capable GPS equipment with 10-meter precision coupled with DGM instrumentation.

3.6.3.9.2 Portions of RC1, RC2, and the ARNG property outside of the *interpreted impact areas* not previously characterized will be investigated in a similar fashion, relying on anomaly data collected along reconnaissance transects. Reconnaissance transects will be nonintrusive, instrument assisted transects separated at roughly 500 feet intervals to identify areas of potential munitions contamination. Areas requiring additional coverage may be further defined with intermediately spaced transects or grids.

3.6.3.9.3 DGM transect field teams will deploy man-portable instrumentation and WAAS-capable GPS units to map anomalies along transects. Transect paths will generally be subparallel, but may divert around large obstacles (e.g., trees, wetlands, large rocks, etc.).

3.6.3.9.4 Along surface reconnaissance transects, crews will count anomalies and record the position of any MEC and MD encountered, and any other forensic evidence of HE use (e.g., fragmentation, HE craters). The transect lines will be broken into individual 100-foot segments, with transect lines kept straight as possible along each segment. Reconnaissance transect positions will be recorded during geophysical data collection using a PPK- (e.g., a Trimble XH GPS system) or WAAS-capable GPS unit. The accuracy of the GPS positioning of the transect segments may be limited by the brush and tree cover; however, because of the number of surveyed segments, survey data defining relative location of transects can be used to determine accurate positions of transects.

3.6.3.10 DGM Survey Grids

3.6.3.10.1 The DGM grid survey will be conducted in areas of high, medium, and low anomaly density. DGM grid surveys will be accomplished using PPK GPS equipment offering 0.25-meter or better precision coupled to the geophysical systems or line-and-fiducial methods.

3.6.3.10.2 Grids will be nominally 50 by 50 feet laid out in a north-south orientation where possible. Any deviations due to terrain considerations will be noted. The southwest (or equivalent) grid corners will be surveyed using PPK GPS equipment to obtain sub-meter precision. DGM survey lane spacings will be at 2.5 feet (0.75 meters). The DGM survey will be conducted IAW HGL SOP 6.01 for DGM surveying with a Geonics, Ltd., EM61-MK2 (see Appendix I).

3.6.3.10.3 The 2001 aerial photograph analysis identified isolated areas of ground scars, cleared earth, and other disturbances that were not included in *interpreted impact areas.* A percentage of grids will be placed in these outlying areas. The grids will be evaluated using DGM surveys followed by intrusive investigation of MEC-like anomalies.

3.6.3.10.4 Grid coverage will be equal to a minimum of 20 percent of transect acreage. Grids will be evaluated using DGM techniques that incorporate intrusive investigation of anomalies most likely to represent MEC or MPPEH in the grids. DGM of the gridded areas as defined will be conducted to quantify the types and densities of potential MEC present within that MRS. The size of the survey area may be increased to address intrusive and nonintrusive transect investigation results and identified site conditions, and the shape may be changed based on the spatial distribution of anomaly density and the professional judgment of HGL geophysicists.

3.6.3.10.5 Grids will be placed in high, medium, and low density areas to characterize the distribution, type, and depth of MEC. Grids may also be used in “transect-like” configurations (e.g., 10 by 250 feet) centered on the boundary of the target as determined from any AGM operations along transects. Grid sizes will average a 2,500 square foot equivalent. The locations and distribution of grid types will be determined in consultation with the PDT. . In addition, the grids will be adjusted to allow the best coverage possible based upon site conditions including vegetation, terrain and gaining the best quality geophysical and GPS data.

3.6.3.10.6 DGM grid surveys will be completed using a cart-mounted geophysical instrument, for example, the EM61-MKII time-domain electromagnetic metal detection system equipped with RTK, a PPK GPS system, or the line-and-fiducial method for positional accuracy.

3.6.4 AGM Transects

3.6.4.1 The RI technical approach incorporates the use of DGM rather than AGM, where possible; however, in some areas DGM may not be possible due to unfavorable site conditions limiting DGM equipment access. In areas where DGM is not practicable, AGM methods such as “mag and dig” may be used. The procedures for conducting AGM are described below.

3.6.4.2 An AGM field crew will be used to perform a subsurface analog metal detection and investigation survey in real time. UXO technicians will compose the teams to detect and map anomaly locations prior to intrusive investigation. The AGM team will fill data gaps in the DGM survey by continuing the proposed transect path. The AGM team will cover a 3-foot-wide path along the proposed transect until the DGM process can be continued.

3.6.4.3 The AGM team will tally the number of anomalies along each 100-foot transect segment and will record the number of anomalies at 100-foot interval waypoints. All anomalies will be intrusively investigated. A single waypoint will be recorded for each 100-foot segment that summarizes the quantity and depth of CD and non-identifiable MD (i.e., undifferentiated HE fragmentation). For MEC and identifiable MD, depth, category (MEC, MD, etc.), and a narrative description of the recovered item (e.g., 60mm mortar, 2.36-inch rocket fins, etc.) will be recorded and its waypoint recorded at the intrusive location.

3.6.4.4 If MEC is identified, all activities within the particular transect will be halted, and the SUXOS will be notified immediately. Photographs, a detailed description, and a precise location using GPS will be captured for each MEC item identified. Locations may be temporarily captured in the field log in local grid coordinates.

3.6.5 AGM Grid Procedures

3.6.5.1 As described earlier, the technical approach favors the use of DGM transects and grids, but in areas inaccessible to DGM, such as steep slopes and rough terrain, AGM grids may be established. The procedures to establish AGM grids are as follows:

3.6.5.2 A UXO field crew will be used to perform a subsurface analog metal detection and investigation survey in real time. The field crew will detect, mark, and map anomaly locations prior to intrusive investigation.

3.6.5.3 Each AGM grid will be seeded with four (4) coverage seeds, consisting of 6-inch steel nails driven into the ground flush with ground surface. Two detection seed items comprised of a small and a medium ISO, each buried at the maximum reliable depth of detection as determined at a test plot using an EM61-MK2. Reliable detection is defined as a coherent, recognizable anomaly in each of first three time-gates of the EM61-MK2.

3.6.5.4 Upon arriving at a previously marked grid, the field team will lay out measuring tape on parallel ends of the grids, and mark off lanes along the tape using alternating colors of flagging or pin flags. Instrument operators will collect data in alternating 4-foot-wide passes so that an alternating set of passes will be performed within each lane such that the survey completely covers the 5-foot-wide swath. Operators will be responsible for identifying and intrusively investigating anomalous responses. A single waypoint will be recorded at each grid that summarizes the quantity and depth of CD and non-identifiable MD (i.e., undifferentiated HE fragmentation). For MEC and identifiable MD, depth, category (MEC, MD, etc.), and waypoint, as well as a narrative description, of each recovered item (e.g., 60mm mortar, 2.36-inch rocket fins, etc.) will be recorded at the intrusive location. If MEC is identified, all activities within the particular grid will be halted, and the SUXOS will be notified immediately.

3.6.6 Project-Specific Constraints, Conditions, or Features Potentially Affecting Geophysical Data Collection

3.6.6.1 Geologic Conditions

3.6.6.1.1 Camp Butner is located within the Piedmont Province, which lies between the Coastal Plain and the Blue Ridge Mountains. The Piedmont is characterized by gently rolling, well-rounded hills and long low ridges with only a few feet of elevation difference between hills and valleys. Its geology is characterized by numerous rock formations of different materials and ages representing ancient eroded mountain chains. The soils are of high clay content. Prior investigations have shown that some anomalies were caused by volcanic rock present onsite. HGL will select the appropriate equipment (such as a White's magnetometer) to reduce difficulty in interpretation of results.

3.6.6.2 Surface and Groundwater Conditions

3.6.6.2.1 Man-made ponding may present obstacles to straight-line surveying; however, no significant impact is anticipated.

3.6.6.3 Vegetation

3.6.6.3.1 It is anticipated that some vegetation removal will be required. Vegetation removal will be conducted IAW with this WP.

3.6.6.4 Utilities and Man-Made Features

3.6.6.4.1 Presently, a large percentage of the land within the former Camp Butner site is undeveloped, with the exception of the Town of Butner. Current land uses are predominantly agriculture/open space and residential. Private land ownership parcels may exceed 200 acres and are located within areas utilized for agriculture and forestry. Residential land use of the site is typified by low-density development along main roads. Cultural interferences are expected to be minimal and will be accounted for in the data collection.

3.6.6.5 Site-Specific Dynamic Events

3.6.6.5.1 Dynamic events such as rain, lightning, and solar flares may affect geophysical data collection. Procedures for geophysical survey operations when these events occur follow.

3.6.6.5.2 *Rain* – The effect of rain on geophysical operations is primarily dependent on the instrument being used and the physical site conditions (terrain and vegetation). Most of the instruments commercially available are relatively water resistant. Additional measures will be taken by the survey teams (such as covering connections with plastic sheeting) to reduce the possibility of moisture impacting the instrument's electronics. When possible, survey teams will only operate the instruments in the rain under very light rain conditions (drizzling). If the rain persists and the survey team leader determines that there is a potential for an impact to the data quality, or that moisture could be getting into the instrument, field operations will cease and the project geophysicist will be notified. Operations will continue after the rain has ceased or has reduced to a drizzle and conditions are deemed safe by the UXOSO.

3.6.6.5.3 *Lightning* – Aside from the obvious safety hazard discussed elsewhere in this WP, lightning may cause a phenomenon known as “sferics,” “atmospherics,” or electromagnetic noise, which may impede the performance of electromagnetic sensors. Lightning activity in the area will be monitored, and data collection will be halted if it presents a problem until the activity ceases.

3.6.6.5.4 *Solar Flares* - Solar flares, a sun-generated phenomenon typically occurring in the afternoon, can temporarily generate high-magnitude magnetic noise sufficient to occasionally make electromagnetic sensors unusable for the duration of the event. Solar flares are typically readily observable by the instrument operators (throughout the area) as rapidly fluctuating signal readings with no apparent cultural or survey source. The UXOQC will log the time intervals when solar flare activity is observed to help determine whether any data (for digital geophysics) have been affected. The National Oceanic and Atmospheric Administration maintains a helpful website at http://spaceweather.com. Solar flare activity will be monitored.

3.6.6.6 Data Analysis and Anomaly Selection

3.6.6.6.1 DGM data files will be logged upon receipt in a survey database, recording file name (incorporates date, sequential file, and time stamp), type of data (QC test type, transect survey), area of concern or grid, and DGM system identification.

3.6.6.6.2 Geophysics relies on contrasts between the target materials and the background matrix to identify “anomalous” responses. A geophysical anomaly or target is defined as a discrete area of geophysical response that (1) is elevated with respect to the local background conditions, (2) has a shape and amplitude that is interpreted to be potential subsurface MEC, and (3) is not related to an obvious cultural feature or utility. Anomaly selection will be accomplished by identification of discrete responses representative of cylindrical metal objects that are distinct from background levels.

3.6.6.6.3 DGM data will be downloaded each day to ensure data preservation. Downloaded files will be screened for coherence and file integrity prior to uploading for data processing. Data processing will be accomplished using a combination of GIS, geophysical, and off-the-shelf mapping software specific to the geophysical and positional instrumentation deployed. These could include DAT61Mk2, ESRI ArcGIS, Geosoft Oasis *montaj*, and/or Golden Software SURFER, and Microsoft Excel, Word, and Access programs.

3.6.6.6.4 Field editing of the raw data will include an initial review to check for proper file identification and content. Standard preprocessing will include a check of the precision of the navigational data (i.e., a point-precision test), a determination of the comprehensive coverage to identify any data gaps that may require additional surveying, a check of noise levels to ensure that they are within acceptable limits, and an identification of anomalous data spikes or dropouts that may be associated with environmental or cultural features.

3.6.6.6.5 Upon acceptance of the QC tests, further data processing will typically include corrections for navigational errors, timing errors, and instrumental drift. Multiple data parameters, including signal-to-noise ratios, anomaly shape, decay slope, and response amplitude will be used to identify and evaluate potential target anomalies.

3.6.6.6.6 Anomaly shape (symmetry and width) will be reviewed by the data processor to remove spurious noise spikes and obvious interference (e.g., stationary responses, start/stop anomalies, etc.). Time decay curves recorded using the multiple time gates of the instrumentation will be analyzed to attempt to improve identification of metallic versus “false positive” responses. Response amplitude will be calculated using a weighted sum of responses from all time gates.

3.6.6.6.7 The EM61-MK2 instrument manufacturer suggests that instrument “noise” for a well-maintained system will be on the order of 1.5 mV or less in channel 3 of the recorded data. The effects of motion-induced noise (bounce and geologic variability) as the system is transported over the site must be added to the cumulative noise total. This is a site-specific variable. Anomaly discrimination from the background matrix requires sufficient contrast so that the anomalous response is coherent and recognized. A signal-to-noise ratio determined from the responses obtained at the IVS (nominally 2:1) will be used to screen potential anomalies. A detection “floor” will be established for each site, based on the minimum signal-to-noise ratio obtained over the target items seeded in the IVS plot. The floor is derived from the ambient background response variations, but must be chosen with respect to the minimum responses to known and/or predicted target responses.

3.6.6.6.8 The shape of the anomaly will also be evaluated. Abrupt spikes with gradual decay are not representative of true anomaly sources. Because of the response parameters of the electromagnetic method, an anomaly must have general symmetry. The geometry of the geophysical detection and mapping equipment precludes narrow 2- or 3-point anomalies from interest. Anomalies more than a few meters wide will not be representative of discrete sources, but rather will likely be a potential trench or pit containing multiple metal items. The symmetry and width of all potential anomalies will be evaluated for inclusion on the MRS dig lists.

3.6.6.6.9 Additionally, the signal (voltage) decay for metal targets across the four time windows offered by the EM61-MK2 generally conforms to a geometric progression such that the response of channel 3 is greater than that of channel 4, channel 2 is greater than that of channel 3, and channel 1 is greater than that of channel 2. It is noted that there will be considerable variation in the decay fall-off. This variation provides information that can be useful in categorizing anomalies that may be of lesser concern for a munitions response characterization. Those anomalies with decay progressions that do not approximate this form are unlikely to be of interest and will be de-prioritized or deleted. The relative amplitude of the anomalous peaks must also be considered when a limited number of all possible anomalies will subsequently be investigated. A weighted sum of contributions from each response channel will be calculated for potential anomalies. Very low sums, for example within 2 to 3 mV of the detection floor, will be of lesser interest. Conversely very high anomalies, those greater than the maximum response modeled for the largest munition of concern, will also be of lesser interest. Potential anomalies that fall into these categories will also be de-prioritized.

3.6.6.6.10 The geophysical data collected will be evaluated against anomaly selection criteria to determine which anomalies likely represent MEC and will require further intrusive investigation. This selection criterion will be rule-based and not a pre-set metric; instead, it will be determined from an iterative approach conducted during the geophysical investigation. The initial anomaly selection criteria are presented below. Selection criteria may be modified following an analysis of data collected during the GSV process and the initial DGM survey data to identify appropriate parameters. Anomaly selection will include the following:

- 5:1 signal to noise ratio (peak to 50-point modal response);
- >5 points anomaly width;
- Anomaly symmetry: sum of peak and preceding 3 points (ramp up) will be at least 60 percent of sum of peak and subsequent 3 points (ramp down) along a transect; and
- Signal decay progression: Channel 1> Channel 2> Channel 3> Channel 4.

3.6.6.6.11 The data will be profiled and contoured using appropriate software (e.g., Geosoft Oasis, Golden Software Surfer, or equivalent) to create data image map plots. Automatically picking algorithms, such as Geosoft's Oasis montaj UX-Detect module, may be used where appropriate to select targets. Additional targets may be added or removed based on inspection of the profiled and plotted data. A priority ranking sliding scale will be developed based on above anomaly selection parameters and validated or refined based on the physical properties of subsequent dig results. Targets that achieve a higher ranking possess anomaly characteristics with an increasing potential for representing the type of MEC that may be encountered in the MRS. Lower rankings will be assigned to anomalies with a lesser potential for representing MEC. The dig list provided to the intrusive investigation team will comprise the anomalies deemed most likely to be sourced by MEC or MD.

3.7 ANOMALY REACQUISITION AND INTRUSIVE INVESTIGATION

3.7.1 Dig Sheet Development

3.7.1.1 After targets have been selected, hard copy and digital dig sheets will be submitted to the UXO dig team for intrusive investigation. The dig sheets will be in compliance with USACE DID WERS-004.01 and will be consistent with Chapter 7 of EM 1110-1-4009. The result of the data processing will be a table of anomalies to be delivered to the UXO dig team for investigation, recovery, and disposition of the anomaly sources.

3.7.1.2 The field geophysicist will assign each anomaly a unique target identifier and will enter the information for the target into the database. The dig sheet also will include QC target anomalies. At a minimum, the following information will be included in the database for each targeted anomaly:

- Unique target identification including grid block,
- Easting and northing positions,
- Channel identification,
- Response amplitude of the peak response, and
- Dig priority based on correlation to target attributes.

3.7.2 Anomaly Reacquisition and Marking

3.7.2.1 The purpose of the reacquisition and marking process is to establish the boundaries of the survey area and to identify geophysical anomalies previously identified. The reacquisition process also will field verify the presence of the formerly identified anomalies and flag the anomalies selected for excavation.

3.7.2.2 Once an anomaly has been chosen for investigation, a reacquisition team will proceed to the anomaly coordinate location using an RTK or PPK GPS unit, or local coordinates measured from the southwest corner of the grid. The coordinate position of the anomaly will be surveyed with equipment of the same instrumentation as that used for the initial geophysical survey. The anomaly will be identified, and a flag with the anomaly number will be placed on the apparent center peak of the anomaly.

3.7.2.3 Once the anomaly coordinate location has been recovered, the reacquisition team will document and remove any metal surface debris found within the critical search radius of the anomaly (generally a 3-foot radius), and then determine the continued presence or absence of a residual anomaly. A visual search of the critical radius areas may be augmented by the use of handheld electromagnetic metal detectors or magnetometers. Locations of materials removed from within the critical search radius will be noted to ensure that the removal of any associated geophysical anomaly sources is documented.

3.7.3 Feedback Process

3.7.3.1 Ground-truthing in the form of reported results from intrusive investigation of anomalies will be used to refine, if necessary, the coordinate locations of anomalies to be investigated, as well as to assess the representativeness of the discovered anomaly sources. Intrusive investigation results with sources that are not well understood will be flagged and reviewed by the project geophysicist and the intrusive investigation team leader to ascertain the credibility of the reported source. These assessments will be reported to the QC geophysicist. Anomalies that are not resolved to the satisfaction of the QC geophysicist may be reinvestigated and/or resurveyed.

3.7.4 Intrusive Investigation

3.7.4.1 The intrusive investigation of potential MEC includes field procedures, MEC/material documented as an explosive hazard (MDEH)/RRD disposition/processing, and public/personnel safety concerns.

3.7.4.2 After completion of the reacquisition and surface clearance tasks, excavation, identification, and sampling, if applicable, of subsurface anomalies will be conducted to determine if MMRP-related materials are present.

3.7.4.3 Unrecovered anomalies that have no clear external source (e.g., surface clutter, terrain irregularities, and dense vegetation) will be reconfirmed by deploying the EM61-MK2 in real-time mode. Anomalies that cannot be recovered will be reported to the QC geophysicist for reevaluation and explanation to the project team.

3.7.4.4 Because future remediation/removal activities are dependent on the results of the RI activities described in this plan, supplemental information about RA approach, procedures, and site-specific conditions will be incorporated into the RI report issued upon the completion of the field investigation activities. As a result, site-specific conditions (anomaly identification and analytical data) will be included in the RI report and will provide data and supplemental information required for future remediation, as required.

3.7.4.5 A qualified MEC dig team will be deployed to investigate the identified anomalies. The MEC dig team under the direct supervision of the SUXOS will conduct intrusive investigation of the identified anomalies. If MPPEH is found during anomaly investigation, it will be evaluated as described in Sections 3.8 and 3.9.

3.7.4.6 All personnel involved in the investigation of buried anomalies shall meet the minimum qualifications outlined in the DDESB TP-18. The following procedures will be followed during the intrusive investigations:

- Targets selected for identification will be initially investigated by hand using hand tools. If the anomaly cannot be uncovered within 2 feet, the UXO team will note the location of the anomaly for subsequent excavation with mechanized equipment IAW the procedures in the approved ESP.
- If the subsurface contact proves to be non-MEC, it will be removed and the hole rechecked with a handheld magnetic locator. If the hole is "clean," the UXO technician will move on to the next contact. If the contact is a suspect MEC item (whether UXO or DMM), it will be marked with a pin flag for disposal as required. An area with a 1-meter radius around the identified anomaly will be checked to ensure that the primary anomaly was not masking additional anomalies and to ensure that all anomalies have been investigated.
- All anomalies identified as MEC will be left in place until the condition and identification is assessed by qualified UXO personnel in order to determine ultimate disposition. Digital photographs of all MEC will be taken for reporting purposes. Dig sheets and photographs will be linked to the project GIS. QC checks of the cleared designated anomaly locations will be completed by the UXOQCS.
- Areas or excavations that present discolored soils, burned material, leaking munitions, or disposal pits will be marked and logged. The SUXOS will notify the HGL PM and installation personnel (if on ARNG property) as soon as practical upon such a discovery. The HGL PM will notify the USAESCH PM and supplemental project personnel, if necessary.
- After the removal of the anomaly or the blown-in-place (BIP) disposal of the MEC, the excavation will be backfilled and restored as closely as possible to its original condition IAW the contract specifications.
- The field teams will intrusively investigate all MEC-like anomalies identified within the grids. Anomalies will be excavated IAW this WP and HGL's intrusive investigation SOPs to positively identify each item.
- The SUXOS will maintain a detailed record of recovered items, including amounts of MEC, proper nomenclature and condition, location, depth, and disposition. The record will include the classification of the item (i.e., DMM, UXO, or MC with enough explosives to

present an explosive hazard) and the mark/model number of the item. The locations of large area (saturated response) anomalies will be identified and the sources characterized, if possible.

- Investigative results will be recorded electronically. Electronic dig sheets will be annotated, as appropriate, and all columns completed.
- Excavations will be backfilled and the ground surface restored as near as practical to its original condition.

3.8 MEC PROCEDURES

3.8.1 Exclusion Zones

3.8.1.1 Prior to any MEC operations, the EZ must be clear of all nonessential personnel. Nonessential personnel will not be allowed back into the EZ until all MEC operations within that zone are complete. Once MEC operations within the zone have been concluded, the SUXOS will open the area to normal activities. Exclusion zones will be established IAW the approved version of the ESP.

3.8.1.1 Hazard Assessment

3.8.1.1.1 The hazard assessment is contained in the approved version of the ESP.

3.8.1.2 Explosive Safety Quantity-Distances

3.8.1.2.1 Intentional detonations and Unintentional detonations distances will be IAW the approved version of the ESP.

3.8.1.3 MGFD

3.8.1.3.1 The MGFD for the MRSs will be IAW the approved version of the ESP.

3.8.1.4 MSDs

3.8.1.4.1 During MEC operations, nonessential personnel will remain outside the HFD from an operation at all times. The HFD was established in the approved version of the ESP. If an item with a greater HFD or K40 is found, the MSD and team separate distance will change IAW DDESB TP-16. If indicated, the extended MSD will be immediately implemented, operations may continue, and an amendment to this WP and the approved ESP will be initiated immediately.

3.8.1.5 Engineering Controls

3.8.1.5.1 MEC items will be disposed of on an individual basis. If required, engineering controls IAW the approved version of the ESP will be implemented.

3.8.2 MEC Identification

3.8.2.1 A UXO Technician III will make the initial determination whether an MPPEH item is MEC. The SUXOS and UXOSO must be in agreement on the nature and condition of a live item before any action is taken. If the nature of an item remains in question after field evaluation by UXO technicians, digital data and images of the item will be forwarded to the USACE and HGL's offices for consultation.

3.8.2.2 Chemical Warfare Material

3.8.2.2.1 This site is not suspected of containing CWM. However, during the RI, if HGL identifies or suspects the presence of unknown liquid-filled munitions, all personnel will immediately withdraw upwind from the work area and notify the UXOSO, SUXOS, and OESS. The OESS will notify the USAESCH PM. HGL shall secure the area and provide two personnel located upwind of the suspect item(s) to secure the site until relieved by DA emergency response personnel. Additional support may be required by the emergency response personnel, such as construction of blast mitigation controls. Additional reporting instructions are contained in the USACE memorandum "Notification Procedures for Discovery of RCWM During USACE Projects," EP 75-1-3, and at:
http://www.hnd.usace.army.mil/oew/policy/IntGuidRegs/RCWMNotificationmemo_w_encl23April04.pdf.

3.8.2.3 Acceptable to Move MEC Items

3.8.2.3.1 Those items identified as being *acceptable to move* may be collected and consolidated for disposal within the MRS where the item was originally found. This determination will be made IAW the approved ESP.

3.8.2.4 Unacceptable to Move MEC Items

3.8.2.4.1 BIP operations will be conducted for all MEC items that are deemed *unacceptable to move*. BIP disposal operations will begin at the work site only after all nonessential and non-UXO personnel are out of the MSD of the ordnance being detonated.

3.8.3 MEC Disposal

3.8.3.1 All MEC will be disposed of by detonation utilizing standard demolition procedures as outlined in TM 60A-1-1-31. The following paragraphs describe in general the procedures HGL will use to detonate MEC items at the MRSs. All detonation/access holes will be backfilled. Demolition operations if required, will generally take place at the end of the work week, weather permitting. The UXOSO is responsible for determining whether minimum safe conditions to conduct demolition operations are met. The SUXOS and UXOQC/UXOSO, in coordination with USACE, will discuss all occurrences where 24-hour security needs to be provided for MEC items awaiting disposal.

3.8.3.2 Team personnel will provide perimeter security during demolition operations. Personnel safe separation distance for demolition operations will be IAW DDESB TP-16. The following paragraphs describe the procedures that will be used to detonate UXO items.

3.8.3.1 Site Control

3.8.3.1.1 Site access and site control will be maintained IAW the approved ESP.

3.8.3.2 Equipment

3.8.3.2.1 Standard electric and nonelectric demolition equipment will be used, to include remote firing devices. Procedures to be used will follow the guidelines dictated by TM 60A-1-1-31. Although use of electrical disposal procedures are anticipated, nonelectrical procedures are included to provide procedural guidance should a circumstance arise where nonelectrical firing procedures are the most prudent means of initiating a demolition shot.

3.9 MATERIAL POTENTIALLY PRESENTING AND EXPLOSIVE HAZARD

3.9.1 All MPPEH will be processed and disposed IAW Chapter 14 of EM 1110-1-4009, dated June 15, 2007, and Errata Sheet No. 2 as well as DOD Instruction Number 4140.62, November 25, 2008, *Material Potentially Presenting an Explosive Hazard*. Additionally, site personnel will adhere to HGL SOP 15.03, MPPEH Inspection, Management and Processing (See Appendix I), which establishes overall practices for HGL UXO-qualified personnel inspecting, processing, safeguarding, and managing MPPEH during MEC activities.

3.9.2 Removal and Disposal

3.9.2.1 Within or adjacent to each grid actively undergoing intrusive investigation, a UXO Technician III will establish a temporary collection point for large MD, RRD, and CD. Smaller items will be placed in plastic buckets. During operations, the team member responsible for the intrusive operations will inspect each anomaly for the presence of explosives. MD, RRD, and CD items that are free of explosive contamination and do not require venting will be placed in a collection point. Upon completion of operations in that grid, the material in the temporary collection points will be inspected. The UXO supervisor will perform a second inspection of the material to ensure that it is free of explosives and other hazardous materials (HAZMATs). The SUXOS will oversee the inspection of each item a third time as the MD and RRD is placed in secured containers. The UXOQCS will verify that all MD and RRD placed in secured containers are free of explosive hazards.

3.9.3 DD Form 1348-1A

3.9.3.1 The SUXOS will certify and the USACE OE Safety Specialist will verify that the debris is free of explosive hazards. If the OESS is not on site, the UXOQCS will sign as the verifier. DD Form 1348-1A will be used as certification/verification documentation. All DD 1348-1A forms will clearly show the typed or printed names of the contractor's SUXOS and UXOQCS, as well as the organization, signature, and home and field office telephone numbers for the persons certifying and verifying the debris as free of explosive hazards. The form will state the following if only MD is being processed:

> This certifies and verifies that the munitions debris listed has been 100% properly inspected and to the best of our knowledge and belief, is free of explosive hazards.

3.9.3.2 If RRD is being processed with MD, the form will state the following:

> This certifies that the material listed has been 100% properly inspected and, to the best of our knowledge and belief are free of explosive hazards, engine fluids, and illuminating dials and other visible liquid hazardous, toxic, and radioactive waste materials.

3.9.3.3 The SUXOS will ensure that a DD Form 1348-1A is completed for each container prior to transfer. The form will contain the following information:

- Location where material was obtained,
- Basic material content (type of metal; e.g., steel or mixed),
- Estimated weight,
- The unique identification number of each container, and
- Seal identification number.

3.9.3.4 All material documented as safe (MDAS) will be disposed of at a recycler where it will be processed through a smelter, shredder, or furnace prior to resale or release IAW all governing regulations. If it is discovered during the material transfer and shipping process that a seal has been broken and the chain of custody of the material cannot be verified, the material in question will be subject to reinspection following the established MPPEH process. The MDAS subcontractor will prepare the documentation verifying the demilitarization and final disposition of the material. Copies of all MDAS certification and chain of custody documentation will be provided to HGL for inclusion in the RI report.

3.9.3.5 All material will be accounted for in the daily and weekly reports.

3.10 GEOPHYSICAL MAPPING DATA FOR RI REPORT

3.10.1 The geophysical results will be summarized in the RI report, which will document the site geophysical activities, problems, and lessons learned, and will contain the data files and final colored contour maps of the site geophysical data. Maps will be in colors such that features within the data image are easily distinguished.

3.10.2 In general, geophysical data presented as gridded contour maps will include the following basic map features:

- Title block that includes the site name (grid), location, and date of survey,
- Scale and graphical bar scale,
- North arrow (true or grid),
- Contour interval (color scale bar),
- Color and/or line contours and target symbols, and
- Relevant cultural features (e.g., surface ground clutter that may affect data quality).

3.10.3 The transect track/grid area and the locations of the anomalies will be incorporated into the project GIS. Project geophysical staff will screen potential anomalies by comparing locations with field notes to identify those resulting from cultural clutter. Anomalies of interest will be identified and tabulated for the intrusive investigation. A geophysical response map, an anomaly map, and an anomaly "dig sheet" will be prepared. These will provide intrusive investigation teams with an image of the data, a unique anomaly identification number, relative anomaly values, and coordinates (in UTM meters) for each anomaly.

3.11 MC SAMPLING

3.11.1 MC Soil Sampling

3.11.1.1 This section details procedures, techniques, and equipment that will be used during the former Camp Butner RI field investigation activities to conduct MC soil, sediment, and groundwater sampling activities, if required. Any changes to the proposed approach will be incorporated into the RI WP as an amendment of field change and will be approved by the USAESCH, EPA, and NCDENR.

3.11.1.1 Utility Clearance

3.11.1.1.1 Utility maps for the immediate vicinity of the MRS will be reviewed by HGL personnel prior to completion of intrusive excavation and/or soil boring field investigation activities. Before intrusive activities occur at former Camp Butner, potential underground utilities present within the MRS area of investigation will be identified by applicable local utility personnel. All excavation activities and reporting will comply with the applicable laws, ordinances, regulations, and requirements of the State of North Carolina and USACE.

3.11.1.2 Soil Boring and Sample Logging

3.11.1.2.1 Soil boring or soil excavation will be conducted with a UXO Technician II or above providing oversight of MEC anomaly avoidance procedures. During soil boring sampling activities, the lithology will be classified using the Unified Soil Classification System. The HGL project geologist will record the lithology and document the information in the field logbook and on a field boring log form (Appendix F). Each log will include a complete description of the characteristics of the material collected, as well as conditions encountered. The following sample characteristics will be included in each log:

- Lithology,
- Particle size (visual estimates),
- Color (Munsell),
- Consistency and texture,
- Relative density,
- Moisture, and
- Other distinctive features.

3.11.1.2.2 Soil sampling will be conducted to determine the presence or absence of contamination in the surface and shallow subsurface soil horizons. Sampling depths, sampling methods, and frequency will be based on observations made during investigation activities. In general, samples may be collected from two strata: surface (0 to <0.5 feet bgs) and shallow subsurface intervals (between 0.5 and 2 feet bgs). Observations, sampling rationale, and details of sample collection will be recorded in the soil boring and sample logs. SOPs for the collection and logging of surface and shallow subsurface soil samples are presented in Appendix I. Each sample location will be surveyed, and the coordinates will be recorded on the soil boring logs.

3.11.1.2.3 Completed field forms and survey data will be provided with the former Camp Butner RI report. The following subsections describe the methods and equipment that will be used to collect soil samples.

3.11.1.3 Surface Soil Sampling Procedures (Discrete and Incremental)

3.11.1.3.1 Surface soil samples may be collected throughout the MRS locations as part of the RI field activities. Incremental samples will be collected from surface soil locations. If ISM results indicate that constituent concentrations exceed screening values, then additional ISM surface soil samples and/or subsurface discrete soil samples will be collected in the same general area to delineate the exceedance. If detected concentrations do not exceed criteria, subsurface discrete soil samples will not be collected from the respective general area.

3.11.1.3.2 Discrete surface soil samples and shallow subsurface soil samples may be collected from the ground surface to 2 feet bgs using decontaminated stainless steel equipment, under special circumstances. Incremental samples will be collected using a multi-incremental sample (MIS) sampling tool. QC samples will be collected using the same procedures used for primary environmental samples. Sample collection techniques and methods to be used to collect soil samples are summarized below.

3.11.1.3.3 Surface soil will be collected using stainless steel spoons or trowels and/or specific MIS tools (incremental only, discussed below). For surface and subsurface soil samples, where appropriate, the collected soil will be placed into stainless steel sampling bowls. Samples will be homogenized and placed into appropriate sample containers (e.g., glass jars) using stainless steel spoons, augers, or sampling equipment. All sampling equipment and tools will be decontaminated before use, and all sample jars will be made of glass with Teflon® septa and will be certified as clean by the manufacturer. After samples have been collected, sample containers will be placed in a cooler and maintained at 4°C ± 2°C pending shipment to the laboratory.

3.11.1.3.4 For ISM samples, surface soil will be collected from the SU locations agreed to by the PDT. The typical SU size is anticipated to be 100 feet by 100 feet, although the size and shape of SUs will be based on the evaluation of DGM transect data, reconnaissance transect data, and intrusive investigation data collected as part of the site. Additionally, the size of an SU may be adjusted to encompass site features but the total area will remain the same. The four corners of each SU will be recorded using a GPS unit capable of sub-meter or better accuracy. Before sample collection, all sample increment locations will be screened by a UXO escort using a Schonstedt geophysical instrument. If detection is made of a subsurface anomaly, the sample will be collected from a nearby point that is cleared by the UXO escort. The collected soil will be placed in clean and certified plastic bags; the total weight of all the increments from each SU (regardless of the total number of sample increments collected), shall be at least 1 kilogram but no more than 2 kilograms. When all sample increments have been collected, the bag will be sealed and sent to the analytical laboratory for analysis. The incremental sample preparation conducted by the laboratory includes drying and sieving for all analyses. The procedures are described in SW846 method 8330B. Processed soil will be ground for explosive analyses. The sampling will be conducted in compliance with the ISM described in Section 3.3.3.

3.11.1.4 Shallow Subsurface Soil Excavation and Sampling

3.11.1.4.1 Shallow subsurface soil samples will be collected from depths no greater than 2 feet bgs. Soil boring sampling will be conducted using a hand auger or stainless steel sampling spoons and bowls. Soil samples will be collected from the bucket of the hand auger or stainless steel tools using sampling procedures specified below and in SOP 2.13 provided in Appendix I.

3.11.1.5 Soil Collection Procedures

3.11.1.5.1 Each primary IS collected for Method 8330B (explosives analysis) will be composed of at least 32 increments collected along approximately equally spaced lanes covering each respective SU (100 by 100 foot grid). Each increment will be advanced from 0 to 6 inches bgs using a specialized 8330B coring device. Approximately 1.5 kilograms of soil sample will be collected in each bag. The analytical laboratory will be instructed to remove the metals split for analysis by EPA Method 6020A prior to grinding the soil sample.

3.11.1.5.2 If, based on IS sample analytical results, relevant screening criteria of constituent concentrations are exceeded, HGL will, upon request, collect one discrete shallow subsurface soil sample at IS sample location of concern. Analysis of discrete samples will include explosives (Method 8330A) and select metals (lead, copper, antimony, and zinc) utilizing Method 6020A, as specified in Table 3.1.

3.11.1.5.3 Discrete soil samples will be collected for chemical analysis using disposable, sterile plastic sampling spoons or stainless steel spoons and bowls. Soil will be homogenized in zip-lock bags or stainless steel bowls before being transferred to the sample jars.

All soil samples will be assigned a unique sampling identification number based on the location, media, and sample depth. Samples will be packed in coolers immediately upon collection and tracked using a chain of custody. The samples will be forwarded directly to the analytical laboratory in waterproof coolers on wet ice; both sample jars and ice will be packed in separate bags in a manner to minimize cross-contamination and cooler leakage during shipment. Coolers will be sealed and marked with custody seals to prevent tampering.

3.11.1.5.4 The procedures described below will be followed for collecting soil samples during the RI field investigation:

- Sampling equipment will be thoroughly cleaned and decontaminated before initial use and after each soil sample completion.
- Decontaminated equipment will be air dried before being wrapped in a nonplastic material (e.g., aluminum foil or Teflon®) and stored in a manner that reduces the potential for accidental contamination.
- Containers necessary for soil samples are described in UFP-QAPP Worksheet #19.

3.11.1.5.5 Each sample cooler will contain sufficient ice or blue ice® to maintain sample temperature at 4°C ± 2°C. Before shipment the temperatures of the coolant blank will be recorded. Laboratory personnel will repeat this procedure when the samples arrive at the laboratory. Should the temperature exceed 6°C at arrival at the laboratory, or if there is evidence that the samples have been frozen in transit, the laboratory will contact the HGL PM and project chemist. The HGL PM and project chemist will determine whether the requested analyses should continue on the affected samples or whether the analyses should be cancelled and the samples re-collected.

3.11.2 Sediment Sampling Procedures

3.11.2.1 If surface soil results indicate the presence of a potential source, sediment samples may be collected from surface water locations (ponds, creeks, rivers) identified during the completion of the RI field activities to characterize potential migration of MC. These samples will be analyzed as specified in Table 3.1 and the UFP-QAAP (Appendix E). Specific descriptions of equipment and procedures that will be used to sample the sediment at the specified locations are provided below.

3.11.2.2 Sediment samples will be collected using either a stainless steel hand auger or a stainless steel trowel. HGL field personnel will determine the exact types of sampling equipment based on site conditions. Field decisions will be based on site-specific conditions, and the rationale for these decisions will be included in the field logbook.

3.11.2.3 Sediment samples for explosives and metals analysis will be placed in a stainless steel bowl and homogenized before placing them into the laboratory-specified sample containers.

3.11.3 Groundwater Sampling Procedures

3.11.3.1 Groundwater samples may be collected from existing production wells identified during the completion of the RI field activities. These samples will be analyzed as specified in Table 3.1 and the UFP-QAAP (Appendix E). Specific descriptions of equipment and procedures that will be used to sample the groundwater at these locations is provided in SOP 2.32 Domestic and Public Well Sampling presented in Appendix I.

3.12 SAMPLING QUALITY ASSURANCE PROCEDURES

3.12.1 The following section specifies procedures that will be used to collect QA samples during the RI field activities.

3.12.1 Rinsate Water Collection Procedures

3.12.1.1 The procedures described below will be followed when equipment rinsate samples are collected for water samples during the RI field activities:

- All sampling equipment, including internal components, will be decontaminated before use and between samples using water collected at the approved source.
- Decontaminated equipment will be air dried, wrapped in a non-plastic material (e.g., aluminum foil or Teflon®), and stored in a manner that reduces the potential for accidental contamination.

- Containers and preservation techniques that will be used are listed in UFP-QAPP Worksheet #19.
- A rinsate blank will be prepared from the water used to decontaminate sample collection devices.
- Sample containers will be rinsed once with the water to be sampled (i.e., field blank or equipment rinsate water).

3.12.1.2 The procedures that will be followed for field blank and equipment rinsate water collection for specific analyses are described below.

3.12.1.3 **Explosive Compounds** – For each discrete field blank or equipment rinsate blank prepared for explosive analysis, two 1-liter amber glass containers will be filled to the top, and the Teflon® lined cap will be replaced and tightened securely. The containers will be placed in a cooler and kept at 4°C ± 2°C.

3.12.1.4 **Metals** – For each field blank or equipment rinsate blank sample prepared for metals analysis, one 100 mL or 1-liter plastic bottle (as required by the analysis to be conducted) will be filled to the top. A sufficient amount of 10 percent nitric acid will be added to each sample to lower the pH to 2 or lower, and the plastic cap will be replaced and tightened securely. The bottle will be inverted several times to ensure mixing of the preservative. This preservation technique will be noted on the sample label and chain of custody form. Although refrigeration is not required, the bottle will be placed in a cooler and kept at 4°C ± 2°C.

3.12.2 Duplicate and Triplicate Soil Sampling Procedures

3.12.2.1 Duplicate and triplicate soil samples will be collected as a means of assessing the reproducibility of the soil sampling effort during RI field activities. The procedures for collecting and containerizing field duplicate and triplicate samples will be the same as those used for collecting the primary environmental samples. One duplicate sample will be collected per 10 environmental samples (discrete, sediment, and/or groundwater). One triplicate sample will be collected per 10 ISM SUs (MRS and background). After collection, all sample containers will be properly labeled and stored on site in an ice chest maintained at 4°C ± 2°C, until they are packed and shipped to the laboratory for analysis. (Note: The laboratory has additional QC requirements for duplicate analyses.)

3.12.2.2 The sample volumes necessary for the duplicate and triplicate analyses will be collected in the manner described for collecting parent soil samples. Sample preservation and containerization procedures will be the same as those described in UFP-QAPP Worksheet #19 for the applicable analysis. After collection, all sample bottles will be labeled properly and stored on site at 4°C ± 2°C until they are packed and shipped via overnight delivery to the laboratory for analysis.

3.12.3 Internal Field QC Sampling Frequency

3.12.3.1 Collection and analysis of source water samples, equipment rinsate blanks, trip blanks, and field duplicates/triplicates are provided as QC checks on the integrity of the sample collection, sample handling, and equipment decontamination procedures.

3.12.3.2 The following summarizes the field QC samples that will be collected during the RI field activities:

- One sample of the decontamination source water and one sample of the deionized source water used as the final rinse in the decontamination procedures will be collected in duplicate from these sources and submitted to the laboratory for analysis using the performance demonstrated methods listed in UFP-QAPP Worksheet #23.
- One set of equipment rinsate blanks will be prepared every day that water samples are collected. These blanks will be analyzed for the same compounds and elements as those analyzed for the environmental samples collected.
- One field duplicate for every 10 environmental samples for each medium sampled will be collected at a pre-selected monitoring point. One field triplicate will be collected for every 10 SUs. Field duplicates and triplicates will be collected at the same time and in the same manner as the parent samples. Field duplicates and triplicates are separate samples obtained from the same monitoring point and SU.

3.12.3.3 Field QC samples are included in the method-specific QC discussed in UFP-QAPP Worksheets #12.1 through #12.4.

3.12.4 Sample Identification and Field Custody Procedures

3.12.4.1 The sections below detail the procedures that will be followed in the field for sample identification and handling. Discussions on custody procedures will be adhered to during field sample collection, sample custody, and shipment procedures.

3.12.4.1 Sample Identification

3.12.4.1.1 A sample identification system will be used to identify each environmental sample collected and field QC sample prepared during the RI field activities. This system will provide a tracking procedure to allow information about a particular sample or sample location to be retrieved easily and accurately and to ensure that each sample is unique. The HGL field manager and data manager will maintain a complete list of field sample numbers and site identifications. The first two letters will represent the sample type (IS – Incremental Sample, SS - Surface Soil, SB – Soil Boring). The next letters will designate the former Camp Butner MRS location (RC1, RC2, or ARNG). The last two digits will represent the sample location number. The format of typical field sample numbers is as follows:

Site ID	Sample Description
IS-RC1-05	Soil sample collected from incremental sampling unit from RC1 MRS at location 05
SS-ARNG-02	Discrete surface soil sample collected from ARNG at sample location 02

3.12.4.1.2 **Field Sample Number** – This is a unique designation assigned by the field team to each environmental sample and field QC sample collected. It is an alphanumeric code that indicates the sample number for a site. For example, a field sample number of HGL02 for site ID SS 03 05 would indicate that it is the second soil sample collected from a discrete surface soil sample location. Re-collected samples will be designated with an "R" at the end of the field sample number (e.g., HGL XXR).

3.12.4.1.3 **Duplicate, Triplicate, and Field QC Blanks** – The following QC test and flagging codes will be used to identify duplicate environmental and field QC blank samples:

- A "D" entered in the flagging code field will be used to identify all field duplicates collected in the field.
- A "T" entered in the flagging code field will be used to identify all field triplicates collected in the field.
- An "R" entered in the QC test code field will be used to identify all equipment rinsate blanks collected in the field.
- An "F" entered in the QC test code field will be used to identify all field blanks collected in the field.

3.12.4.1.4 Sample labels will be filled out at the time of sampling and will be attached to each container with waterproof tape. The label will be completed in indelible ink and contain the following information:

- Date and time sample collected,
- Media type,
- Method matrix,
- Purpose of the sample (parameter and sample group),
- MRS location,
- Field sample number,
- Depth,
- Project number and location of sampling,
- Installation,
- Preservative used (if any), and
- Initials of sample collector.

3.12.4.2 Sample Handling, Storage, and Shipping

3.12.4.2.1 An approved vendor will provide the sample containers described in Worksheet #19 of the UFP-QAPP. Preparation certification and lot numbers will accompany all sample containers shipped to HGL from the vendor. The procedures that will be followed when transporting environmental samples and field QC blanks from former Camp Butner to the laboratory are summarized below:

- Sample collection points, depth increments, and sampling devices documented in the field logbooks will be verified with the information written on the sample label and chain of custody form.
- Logbook entries and field records sheets with sample identification locations, dates, times, and names or initials of all persons handling the sample in the field will be completed.

- Custody seals will be wrapped over the cap and down the side of each sample container. Glass sample containers will be wrapped with plastic insulating material (bubble wrap) to prevent contact with other sample containers or the inner walls of the cooler. Samples then will be placed into resealable plastic bags.
- Samples will be packaged in thermally insulated, rigid coolers, according to U.S. Department of Transportation (DOT) Specifications 173, Subparts A and B, and 172, Subparts B, C, and D. Environmental samples and field QC blanks to be submitted to the analytical laboratory will be placed in a sample cooler along with ice and temperature blanks, and the final temperature blank temperature will be recorded. After a cooler is filled, the appropriate chain of custody form will be placed inside a resealable plastic bag and taped to the inside lid of the cooler, and the outer surface of the cooler will be cleaned.
- Custody seals will be attached in two separate locations on the outside of each cooler.

3.12.4.2.2 Sample coolers will be shipped to the analytical laboratory by overnight delivery. After sample collection, all samples will be kept on ice in a cooler containing a temperature blank. Sample preparation and packaging will be completed at the end of each day that samples are collected. When samples are collected over the weekend, the samples will undergo preparation as normal; however, the samples will not be packaged for shipment. Samples collected on the weekend will be kept within a cooler on ice until all samples for the next shipment have been collected. On Mondays following weekends when samples have been collected, the iced samples will be repacked for overnight shipment.

3.12.4.3 <u>Chain-of-Custody Documentation, Traceability, and Sample Integrity</u>

3.12.4.3.1 Chain-of-custody must be maintained for samples transported from the field to the laboratory by common carrier. Completed custody forms must accompany each sealed cooler and are placed in a plastic bag, which is taped to the inside lid of the cooler. The sampling team in the field seals coolers with a custody seal to ensure that tampering would be immediately evident.

3.12.5 Equipment Decontamination Procedures

3.12.5.1 To ensure that chemical analysis results are reflective of the actual concentrations at sampling locations, equipment used in sampling activities must be properly cleaned and decontaminated. Therefore, equipment used to conduct sampling activities will be decontaminated before sampling activities begin, between sampling activities, and after sampling activities have been completed. SOPs for the decontamination of equipment are provided in Appendix I. Information associated with the decontamination procedures to be used during the RI field activities are summarized below.

3.12.5.1 <u>Source Water Analysis</u>

3.12.5.1.1 Deionized and potable water to be used in the decontamination process will be analyzed for all site-related chemicals before intrusive field sampling activities begin. If the water sources are determined to be unacceptable, alternative sources will be identified and tested for the same parameters.

3.12.5.2 Sampling Equipment

3.12.5.2.1 Prior to, between, and after each sample collection event, all sampling equipment coming into direct contact with the soils will be decontaminated by scrubbing the equipment with a laboratory grade nonphosphate detergent (such as Liquinox®) and a potable water solution using a brush, and then rinsed with potable water. All sampling equipment, including stainless steel bowls and stainless steel sampling tools, will first be washed and scrubbed or steam cleaned with potable water. Approved potable water or deionized water will be used for rinsing. Deionized water will be used for all final rinses.

3.13 PROJECT GEOGRAPHIC INFORMATION SYSTEMS

3.13.1 HGL will maintain a project GIS database. The database will be updated daily during field activities, and current maps will be provided with the weekly progress reports. HGL will apply the OE-GIS standard for the creation of datasets. These datasets will identify grid/transect coordinates and identification numbers, dates of field activities, dates of QA/QC inspections, and locations that contain MEC, MPPEH, and MD.

3.13.2 HGL will use, build upon, and manage the GIS data IAW DID WERS-007.01, EM 200-1-2, EM 1110-1-4009, and other applicable IGDs to develop the CSM and monitor project progress. HGL will compile GIS data created during the RAs and EE/CA and develop a comprehensive geodatabase including vector-based site-specific data such as color aerial imagery, transportation feature centerlines, place names, wetlands, flood hazard zones, soil types, and buildings. HGL maintains current ESRI software and will manage the geodatabase in the ArcGIS 10.1 environment. HGL will integrate new environmental data into the geodatabase as necessary, including well locations, sample locations, lab results, locations of sensitive habitats and potential receptors, and ROE data.

3.13.3 GIS data will be developed and delivered IAW DID WERS-007.01. HGL will create two separate geodatabases, including respective pre- and post-project response action geospatial data analyses. The pre-RI geodatabase will be built from existing GIS data. Social, economic, and/or environmental entities that may or will be affected by response actions will be selected and incorporated into GIS “layers” within the pre-RI geodatabase. As the project is executed, the post-RI geodatabase will serve as the comprehensive project geodatabase, incorporating entities impacted by RI/FS activities and potential impacts of future response action activities (if applicable).

3.13.4 Map layers will be developed in conformance with the Spatial Data Standards for Facilities, Infrastructure and Environment (SDSFIE) for installation mapping and geospatial data; data will be projected in the local UTM coordinate system. The establishment of this system will allow the GIS data to be queried, retrieved, and disseminated via password to the USACE, HGL team members, and stakeholders authorized by the USACE. At project conclusion, the geodatabase will be submitted to the USACE. Information about archaeological and culturally sensitive areas and property owner information will not be included in the geodatabase.

3.14 HEALTH AND ENVIRONMENTAL RISK ASSESSMENT

3.14.1 The purpose of a health and environmental risk assessment is to provide an approach that will be used to estimate potential risks to human health and the environment from potential MC contamination resulting in chemical releases to the environment associated with historical activities conducted within the five MRSs located at the former Camp Butner. The conclusions of this evaluation will be used by risk managers to determine whether no further action is appropriate for the MRSs or if any RAs need to be implemented for the protection of human health and the environment.

3.14.2 The current RI sampling approach does not include surface water sample collection and groundwater sample collection is limited to background locations; however based on sample results obtained during the field activities, supplemental samples may be collected to help in the characterization of these media. Therefore, the following sections have been written to provide flexibility to allow for potential risk assessment evaluation of these media.

3.15 HUMAN HEALTH RISK ASSESSMENT APPROACH

3.15.1 The objective of the HHRA is to characterize the potential adverse health effects associated with potential exposures to environmental contaminants at the MRSs in order to identify areas that may need further investigation as well as identifying those that require no further action.

3.15.2 The meet this objective, the HHRA will evaluate potential human exposures to constituents of potential concern (COPCs) identified in the environmental media (soil and potentially sediment and groundwater) at each of the MRSs using methods consistent with the EPA risk assessment guidance provided in *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (EPA, 1989). Other pertinent guidance documents will be used as appropriate and include, but are not limited to, the following:

- EPA *Risk Assessment Guidance for Superfund (RAGS) Volume I, Human Health Evaluation Manuals Part D* (EPA, 2001a), Part E (2004), and Part F (2009a);
- USACE *Military Munitions Response Program, Munitions Response Remedial Investigation/Feasibility Study Guidance* (November 2009);
- USACE *Risk Assessment Handbook Volume I: Human Health Evaluation* (January 1999);
- Risk assessment guidance as provided by the NCDENR Division of Waste Management, Superfund Section, Federal Remediation Branch, including the Federal Remediation Branch Target Screening Values Table (last updated February 2012); and
- EPA *Regional Screening Level Tables and User's Guide* (April 2012).

3.15.3 The HHRA will follow the four-step process of hazard identification, toxicity assessment, exposure assessment, and risk characterization defined by the National Academy of Sciences (1983) and EPA (1989). A qualitative uncertainty analysis discussion will also be included.

3.15.1 Hazard Identification

3.15.1.1 The hazard identification section will summarize the available data that exist for each MRS. Available site data will consist of historical data and the data collected as identified in the RI WP for each specific MRS. Based on historical site data and anticipated RI data collection efforts, the HHRA will focus on potential exposure to surface and subsurface soil. Groundwater, surface water, and sediment will be evaluated in the HHRA, as appropriate, based on the results of the RI data collection efforts.

3.15.1.2 The soil data for each MRS will be summarized in data tables that will include the frequency of detection, the range of laboratory reporting limits, the range of detected concentrations, and the concentration used for screening. The data tables will follow the format for "Table 2" as presented in EPA *Risk Assessment Guidance for Superfund (RAGS) Volume I, Human Health Evaluation Manual Part D* (EPA, 2001a).

3.15.1.3 Where the dataset includes multiple valid results for a sampling location due to the collection of field duplicate or triplicate samples, the determinative results for that location will be selected for inclusion in screening and risk assessment. The selection of determinative results will be made on an analyte-specific basis using the following decision rules:

1. When both samples in the pair of duplicates have detected values, the higher of the two results from the primary sample and its duplicate will be treated as one detected concentration at the location.
2. When only one of the duplicate samples has a detected value, the detected value will be treated as one detected concentration at the location.
3. When both samples have nondetect values, one-half of the lower of the two limits of detection will be used as one nondetected concentration at the location.

3.15.1.4 The data will be presented separately for surface soil and subsurface soil. Surface soil is defined as any surface soil sample beginning at ground surface (0 inches) and ending at less than 0.5 foot bgs. Subsurface soil is defined as any soil sample beginning at 0.5 foot or more bgs. Data will also be presented as appropriate for groundwater, surface water, and sediment.

3.15.1.5 COPCs are defined as the detected analytes potentially related to releases at a site. Analytes not detected in any of the samples collected from a particular medium (e.g., surface soil) will be excluded from further evaluation. For data sets with more than 20 or more samples, a chemical detected at a frequency of less than or equal to 5 percent will not be identified as a COPC. This frequency of detection criterion will only be used after an evaluation of the spatial distribution of the detections demonstrates that the detections are not associated with potential release or migration areas.

3.15.1.6 IAW EPA and NCDENR guidance, COPCs will be identified through comparison of the maximum detected or estimated concentrations in soil to risk-based screening levels. Screening levels will be obtained from the most recent version of the Federal Remediation Branch Target Screening Values Table, NCDENR permanent and interim groundwater standards as presented in the North Carolina Administrative Code at 15A NCAC 02L.0202, and the EPA Regional Screening Level (RSL) Tables available at the start of the risk assessment process.

3.15.1.7 The COPCs in soil for each MRS will be identified using the following methodology:

- The maximum detected concentration of each carcinogenic compound will be compared to the EPA residential soil RSL value (as presented in the references identified above) calculated for an acceptable target cancer risk of 10^{-6}.
- The maximum detected concentration of each noncarcinogenic compound will be compared to the EPA Residential Soil RSL value (as presented in the references identified above). The EPA residential soil RSL will be adjusted downward by a factor of 10 to address the potential presence of multiple noncarcinogenic compounds that may affect the

same target organ, for an acceptable target hazard quotient of 0.1. If the maximum detected concentration is greater than any of the noted residential screening values, the chemical will be identified as a COPC for direct contact with soil and retained for quantitative evaluation in the HHRA.

- For ISM results, the detected concentrations also may be compared to screening levels using a 95 percent UCL (See Section 3.15.2.2.5).

3.15.1.8 The maximum concentrations of the detected compounds in soil/sediment will also be compared to background data to provide an initial determination as to whether inorganic compounds are detected at concentrations that correspond to site background. However, as a conservative measure, inorganic compounds will not be screened out against the background data in the hazard identification process. If an inorganic compound exceeds the residential screening criteria identified above, it will be retained for quantitative evaluation in the HHRA even if the detections of that compound are below the former Camp Butner background concentrations. Site-specific background considerations will be addressed under the risk characterization. This approach is consistent with EPA guidance (2002a) and allows for an evaluation of those COPCs with high background concentrations and their contribution to site-related risks.

3.15.1.9 If groundwater and sediment samples are obtained as a part of the RI data collection efforts, then the constituents detected in these media will also be compared to risk-based screening levels pursuant to the methodology presented above. Constituents detected in groundwater and surface water will be initially screened in comparison to the NCDENR permanent and interim groundwater standards and the EPA RSLs for tap water (if needed). These RSLs address potential exposure through ingestion and the inhalation of volatiles from the use of tap water. Sediment data will be compared to the EPA RSLs for soil, which address the potential for exposure through incidental ingestion, dermal contact, and inhalation of volatiles and particulates.

3.15.1.10 COPCs will be identified as constituents detected at concentrations that exceed risk-based screening criteria. A standardized list of COPCs detected at concentrations that exceed the residential RSLs will be developed for each MRS, and this list of COPCs will be carried through for further quantitative evaluation in the HHRA. A justification will be provided for each compound not identified as a COPC. If a detected constituent has no screening criteria, it will be qualitatively evaluated in the HHRA based on information obtained through a review of scientific literature.

3.15.2 Exposure Assessment

3.15.2.1 The exposure assessment will provide a discussion of the type and magnitude of exposures to COPCs at each MRS. The preliminary CSM will be refined to evaluate the potential fate and transport mechanisms of the COPCs and to identify potential human health and ecological exposure pathways including potential receptors and routes of exposure.

3.15.2.1 <u>Conceptual Site Model</u>

3.15.2.1.1 An exposure pathway analysis will be performed through the development of the CSM. The CSM will identify the relationship among sources, release mechanisms, impacted media, exposure routes, exposure points, and receptors potentially affected by constituents present at or released from the MRS locations at the former Camp Butner.

3.15.2.1.2 There are four elements used to establish a complete exposure pathway:

1. A source and a mechanism of release to the environment,
2. An environmental transport medium,
3. A point of potential contact between a receptor and the environmental medium (referred to as the exposure point), and
4. An exposure route or uptake mechanism.

3.15.2.1.3 The preliminary CSM for MEC and MC at the former Camp Butner is presented as Figures 3.4 and 3.5.

3.15.2.1.1 <u>Potential Migration Pathways</u>

3.15.2.1.1.1 Based on the preliminary evaluation of potential sources and release mechanisms, the preliminary CSM identified five potential transport mechanisms associated with the potential migration of constituents in soil:

- Mechanical redistribution/leaching,
- Wind erosion,
- Plant uptake/bioaccumulation,
- Surface water runoff, and
- Percolation.

3.15.2.1.1.2 Volatile constituents are not contaminants of interest for the site; therefore, they have not been included in the analytical parameters for the RI sampling. The preliminary evaluation of potential migration pathways as presented in the CSM will be updated based on the data collected during the RI.

Potential Receptors and Routes of Exposure
3.15.2.1.2.1 The preliminary CSM also presents the initial evaluation of potential receptors and exposure routes. Based upon the initial evaluation, the following receptors will be considered to have the potential to be present at the former Camp Butner under the current and potential future land use scenarios:

- Outdoor Worker,
- Trespasser,
- Recreational User/Hunter,
- Resident,
- Indoor Worker,
- Maintenance/Utility Worker, and
- Construction Worker.

3.15.2.1.2.2 These potential human receptors are considered to have the potential for exposure to constituents detected in site media through the following exposure routes:

- Inhalation of airborne particulates,
- Incidental ingestion and dermal contact with surface soil,
- Incidental ingestion and dermal contact with subsurface soil,
- Ingestion of vegetation,
- Ingestion of prey animals,
- Incidental ingestion and dermal contact with surface water,
- Incidental ingestion and dermal contact with sediment, and
- Ingestion and dermal contact with groundwater.

3.15.2.1.2.3 It should be noted that the potential receptors do not have the potential for exposure through each of the identified exposure routes. Only select routes are applicable to each individual receptor.

3.15.2.1.2.4 The preliminary evaluation of potential receptors and exposure routes for the former Camp Butner as presented in the CSM will be updated based upon the data collected during the RI and presented for each MRS in the HHRA. The current and future potential receptors and exposure pathways identified for each MRS will be summarized on tables in the format of "Table 1" as presented in EPA *Risk Assessment Guidance for Superfund (RAGS) Volume I, Human Health Evaluation Manual Part D* (EPA, 2001a).

3.15.2.2 <u>Quantification of Potential Exposure</u>

3.15.2.2.1 It should be noted that it is currently assumed that a comprehensive HHRA will not need to be conducted. Therefore, if quantification of potential exposure is determined to be necessary, it will only be undertaken upon the agreement and authorization of all parties involved.

If the hazard identification step results in the identification of constituents at concentrations above risk-based screening criteria, then, consistent with EPA guidance, the magnitude, frequency, and duration of exposure for each complete exposure pathway identified above will be quantified through the estimation of exposure point concentrations and the calculation of intakes.

3.15.2.2.2 For the purposes of the HHRA, the exposures to each potential receptor will be considered to occur entirely within each MRS. Exposure points, the locations of potential contact between a receptor and a COPC, will be defined within each site based on the media-specific data relevant for potential exposure(s). Furthermore, an evaluation of potential outliers (or areas with elevated concentrations of COPCs) will occur with the results clearly identified. As a result, the exposure points may be defined as the data representing the entire site and/or a smaller location based on the media-specific sampling data relevant for that exposure. Exposure units will be identified based on potential source areas and the corresponding potential for receptors to come into contact with the exposure medium. Different exposure units may be identified for different receptors within the same MRS.

3.15.2.2.3 With the exception of exposure units subject to ISM, the exposure point concentration (EPC) for each exposure area will be calculated using an EPA-approved methodology (USEPA, 2002b) such as the 95 percent upper confidence level (UCL) of the means of the data representing the exposure area. The most recent version of the EPA software ProUCL (current version 4.1.01) will be used to perform the statistical analysis as needed for discrete samples (EPA, 2010a).

3.15.2.2.4 The ProUCL version 4.1.00 technical guide (EPA, 2010b) indicates that a minimum of eight detections is required to support a robust statistical analysis of the data distribution. For datasets with four to six or fewer detections, the technical guide suggests use of an ad hoc method (e.g., median or mode) to identify the EPC. IAW this recommendation, the median result will be used as the EPC for datasets with limited detection frequencies (fewer than six). For datasets with more than six detected results, ProUCL will be used to calculate the EPC. For nondetect results or results qualified as blank contamination, the limits of detection will be entered into the ProUCL input file, and the result will be identified as a nondetect. If the ProUCL analysis recommends a statistical value that exceeds the maximum detected concentration, the maximum detected concentration will be identified as the EPC.

3.15.2.2.5 A 95 percent UCL will also be calculated for samples collected using ISM. According to recent guidance from the Interstate Technology & Regulatory Council (2012), calculation of a 95 percent UCL for ISM data requires a minimum of three ISM samples, and with ISM data, the 95 percent UCL will be used as the EPC even if it exceeds the maximum reported concentration. The ProUCL program is not considered appropriate to use with ISM data as it was developed with algorithms for discrete sample datasets. Two statistical methods are considered appropriate for calculating the 95 percent UCL for ISM data, the Student's-t and Chebyshev, and these methods will be used to calculate the 95 percent UCL for each ISM dataset as needed.

3.15.2.2.6 For each complete exposure pathway and receptor, the average daily dose (ADD) (or average daily exposure [ADE] for inhalation pathways) also will be calculated to estimate a potential receptor's daily intake from exposure to compounds. According to EPA (1989), the exposure dose should be calculated by averaging it over the period of time for which the potential receptor is assumed to be exposed. For compounds with potential carcinogenic effects, the lifetime ADD should be calculated to estimate potential exposures over the course of a lifetime (70 years) (EPA, 1989). Consistent with EPA guidance, reasonable maximum exposure (RME) scenarios will be evaluated in the HHRA. The RME scenario represents the maximum upper bound exposure that a receptor could reasonably experience at a site. Most individuals will not be subject to all conditions that comprise the RME scenario. Individuals who do not meet all conditions in the RME scenario have lower potential exposures to constituents and, therefore, lower potential hazards and risks associated with those exposures.

3.15.2.2.7 The exposure parameters that will be used to evaluate the current and future potential receptors and exposure pathways identified for each MRS will be summarized on tables in the format of "Table 4" as presented in EPA *Risk Assessment Guidance for Superfund (RAGS) Volume I, Human Health Evaluation Manual Part D* (EPA, 2001a). These tables will summarize the values used to calculate the daily intakes for the RME scenarios.

3.15.3 Toxicity Assessment

3.15.3.1 The toxicity assessment section will summarize the available toxicity data for the COPCs identified at each MRS, including reference doses, reference concentrations, cancer slope factors, and inhalation unit risks. The toxicity data will be obtained from EPA-approved sources pursuant to the hierarchy outlined in the Office of Solid Waste and Emergency Response (OSWER) Directive 9285.7-53 (EPA, 2003), including the following:

- Tier 1 - EPA's Integrated Risk Information System (IRIS) (EPA, 2012).
- Tier 2 - EPA's Provisional Peer Reviewed Toxicity Values: The Office of Research and Development/National Center for Environmental Assessment/Superfund Health Risk Technical Support Center develops these values on a chemical-specific basis when requested by EPA's Superfund program.
- Tier 3 - Other Toxicity Values: Tier 3 includes additional EPA and non-EPA sources of toxicity information, such as CalEPA values, the Agency for Toxic Substances and Disease Registry Minimal Risk Levels, and toxicity information presented in the Health Effects Assessment Summary Tables (EPA, 1997b). Priority should be given to those sources of information that are the most current, have a basis that is transparent and publicly available, and have been peer reviewed.

3.15.3.2 If a value cannot be found in any of the sources listed in this OSWER directive, the toxicity value provided in the EPA RSL tables will be used, if available. As noted previously, if a detected constituent has no screening criteria (and thus has no established toxicity data), it will be qualitatively evaluated in the HHRA based on information obtained through a review of scientific literature.

3.15.3.3 Dermal reference doses and cancer slope factors will be estimated from oral values IAW *Risk Assessment Guidance for Superfund Volume 1: Part E, Supplemental Guidance for Dermal Risk Assessment* (EPA, 2004). Subchronic exposures (e.g., potential exposures associated with the construction worker) will be evaluated using chronic toxicity values.

3.15.3.4 The toxicity information will be summarized on tables in the format of "Table 5" as presented in EPA *Risk Assessment Guidance for Superfund (RAGS) Volume I, Human Health Evaluation Manual Part D* (EPA, 2001a).

3.15.4 Risk Characterization

As noted previously, it is currently assumed that a comprehensive HHRA will not need to be conducted. If all parties agree and authorize the quantification of potential risk associated with the COPCs in site media, then the risk characterization will be a presentation of the calculated risk estimates. Otherwise, the risk characterization will be a qualitative evaluation of potential risk associated with the former Camp Butner.

3.15.4.1 The quantitative risk characterization will combine the toxicity data identified for each COPC with the exposure data for each potential receptor population to estimate potential upper-bound (conservative) cancer risk and noncancer hazard indexes (HIs) for all identified receptors with potentially complete exposure pathways. Cancer risks will be calculated for each COPC within each exposure medium, summed across each exposure medium, and summed across all exposure media for a specific receptor population. The cancer risk calculation will take into account age-dependent adjustment factors for mutagenic chemicals. This cumulative cancer risk will include contributions from both site-related chemicals and chemicals present due to background conditions. For COPCs assumed to cause cancer, the estimated lifetime cancer risks from all exposure pathways for a potential receptor will be compared to the NCDENR and EPA acceptable carcinogenic risk range of 1E-06 to 1E-04, using 10^{-6} as a point of departure and with a preference for achieving the more protective end of the risk range. Compounds that exceed these risk limits will be identified as compounds of concern (COCs) that may require further evaluation and/or risk management decisions.

3.15.4.2 Noncancer risk estimates (an HQ) for each COPC will also be summed across each exposure medium and all exposure media to provide a total HI for each receptor. The estimated total HI from multiple exposure pathways for a potential receptor will be compared to the NCDENR and EPA acceptable cumulative HI limit of 1. If the total HI exceeds unity, COPCs will be segregated by critical effects. The COPCs that contribute to an endpoint-specific HI that exceeds unity will be identified as COCs for further evaluation and/or risk management decisions.

3.15.4.3 As with the cancer risk estimates, the HIs may include contributions from both site-related chemicals and chemicals present at concentrations below background. To distinguish site-related risks and hazards from background risks and hazards, the cumulative cancer risks, total HIs, and target organ HIs will be re-calculated excluding those COPCs determined to be present due to background conditions. The description of the nature and extent of contamination will include an analysis of which analytes represent background conditions.

3.15.4.4 Exposure to lead will be evaluated through the EPA Adult Lead Model (EPA, 2009b) and the EPA Integrated Exposure Uptake Biokinetic Model for Lead in Children (EPA, 2010c).

3.15.4.5 The risk characterization will include a discussion of the uncertainty regarding the data and assumptions used in deriving the risk and hazard estimates. The goal of the risk characterization is to provide stakeholders with sufficient information to make informed decisions about which COCs, media, and areas of the MRSs that may need to be addressed further.

3.16 ECOLOGICAL RISK ASSESSMENT APPROACH

3.16.1 Introduction

3.16.1.1 The purpose of the ERA is to determine whether potentially unacceptable risks are posed to ecological receptors due to exposures to residual MC at any of the former Camp Butner MRSs and, if so, to identify the specific chemical constituent(s) contributing to that risk.

3.16.1.2 As per the *Final U.S. Army Military Munitions Response Program RI/FS Guidance* (USACE, 2009a), the ERA for these sites will be performed based on EPA guidance for conducting ERAs at CERCLA-regulated sites, principally *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Draft* (USEPA, 1997a, as implemented by EPA, 1999a). This approach also is consistent with the guidance for conducting ERAs set forth by the NCDENR (2003). Supplemental ERA guidance from EPA and DoD is also provided in USACE (2010), EPA (1998), EPA (2001a and b), the U.S.

Army Biological Technical Assistance Group (USABTAG) (2002), and from the Tri-Services Environmental Risk Assessment Work Group (TSERAWG) (2008).

3.16.1.3 The ERA process under CERCLA consists of eight steps. This process is separable into two tiers: the screening level ERA (SLERA) and the baseline ERA (BERA) (USACE, 2010). The SLERA includes Steps 1 and 2 of the CERCLA process, and the BERA encompasses the remaining steps (Steps 3 through 8). Step 1 includes the (preliminary) problem formulation, which defines the goals, breadth, and focus of the SLERA, and the ecological effects evaluation, which identifies thresholds of potentially adverse ecological effects for the predicted constituents at the sites. Step 2 of the SLERA includes a (preliminary) exposure estimation for the key ecological receptors identified in the problem formulation, and a risk characterization, which provides a highly conservative evaluation of the potential for risk to those receptors based on the comparison of the estimated exposures to the corresponding toxicity thresholds.

3.16.1.4 The overall objective of the SLERA is to conservatively identify (based on existing site data) those constituents that are at levels in ecologically relevant media sufficient to potentially pose a risk to ecological receptors through one or more complete exposure pathways. Constituents that either lack complete exposure pathways to ecological receptors or are at insufficient concentrations in ecologically relevant media to pose a potential risk are eliminated from further consideration in the ERA process. The remaining constituents are identified as constituents of potential ecological concern (COPECs) for the site in question and are either evaluated further in the BERA or are targeted for remediation or other risk management action.

3.16.1.5 Because the SLERA is a highly conservative screening process and is likely to significantly overestimate the potential for risk, a refined (less conservative) secondary screening evaluation is commonly conducted at the end of the SLERA (USACE, 2010). The purpose of this secondary screening (sometimes referred to as “Step 3a” or the “Refined Risk Estimation”) is to reduce the probability that site constituents that do not pose a potential risk are identified as COPECs and are unnecessarily passed on to the BERA or become drivers in remediation.

3.16.1.6 This WP describes the approach and methods that will be used to perform the SLERA for each of the MRSs at the former Camp Butner. As necessary, the refinement of the screening of COPECs identified in the initial screening will also be conducted for each of these sites. The following sections detail the approach that will be used to conduct the SLERA at these sites.

3.16.2 Problem Formulation

3.16.2.1 The problem formulation lays the foundation for the subsequent risk assessment process. In the problem formulation, the potentially affected environment is defined and preliminary constituents of concern are identified. The following sections describe the components included in the problem formulation.

3.16.2.1 <u>Ecological Setting and Conceptual Site Models</u>

3.16.2.1.1 Camp Butner was originally composed of approximately 40,384 acres that included portions of Granville, Durham, and Person Counties, North Carolina (USACE, 1993). It was active until 1946 and was excessed by the War Assets Administration over the next several years. Approximately 16,558 acres went to the State of North Carolina of which 4,750 acres make up the Camp Butner National Guard Training Center, with the remaining 11,038 acres making up the town of Butner and state-operated farms. Approximately 23,056 acres reverted to the original owners who use the land for agriculture and forestry; approximately 770 acres is used as a Federal Correctional Complex.

3.16.2.1.2 Geographically, former Camp Butner is situated in the Piedmont Province, an area characterized by rolling topography with rounded hills and long, low ridges. The elevation ranges from approximately 280 to 500 feet above mean sea level. The climate includes relatively mild winters and warm, humid summers. Average low temperature is approximately 41ºF in January with the mean daily low of 28ºF. The average high temperature is approximately 78ºF in July with a mean daily high of 90ºF. Annual rainfall averages approximately 47 inches and is well distributed over the year, with an average monthly rainfall of between 3 to 4 inches. The first freeze generally occurs around October 27 and the last freeze occurs around April 11 (USACE, 1993).

3.16.2.1.3 The area contains several perennial streams with numerous intermittent tributaries. These streams generally flow to the southwest. The majority of the area drains into the Knap of Reeds Creek, which is part of the Nuese River watershed. A small portion of the western section of this facility drains to the west into the Flat River. The Flat River also drains into Nuese River. The source of potable water for the town of Butner is the Holt Reservoir (also known as Lake Butner), with a storage capacity of approximately 10 billion gallons. The water system was constructed in 1942 to support 50,000 soldiers at Camp Butner (USACE, 1993).

3.16.2.1.4 The undeveloped hills within the area are forested with various hardwoods including oaks (*Quercus* spp.), flowering dogwood (*Cornus florida*), beech (*Fagus* spp.), sweetgum (*Liquidamber styraciflua*), holly (*Ilex* spp.), hickory (*Carya* spp.), and red maple (*Acer rubrum*). Stands and individuals of evergreens, including loblolly and Virginia pines (*Pinus taeda* and *P. virginiana*, respectively) and eastern redcedar (*Juniperus virginiana*), are mixed with the deciduous hardwoods previously mentioned. The evergreens tend to be found on ridges and south-facing slopes. Hilltops are generally vegetated with hardwoods. The canopy of the forested areas is dense. Species in the sparse understory include highbush berry (*Vaccinium* spp.), dogwood (*Cornus* spp.), poison ivy (*Toxicodendron radicans*), Christmas fern (*Polystichum acrostichoides*), and Japanese honeysuckle (*Lonicera japonica*) (Parsons, 2004).

3.16.2.1.5 The ecological setting of each of the MRSs will be described with regard to significant habitats and potential receptors within each habitat type. Emphasis will be placed on ecologically relevant media within each habitat type (surface and near-surface soil, surface water, and sediment) that could act a source of exposure of ecological receptors to MC within that medium. Because no biological reconnaissance or survey of the MRSs has been conducted specifically for the ERA, the ecological site descriptions are based on existing information of the habitats and biological communities of the former Camp Butner combined with information garnered from the open literature and internet sources. No threatened or endangered species species or critical habitat, however, is documented to exist within the former Camp Butner.

3.16.2.1.6 Based on the CSM illustrated in Figure 3.5, surface and shallow subsurface soil are the principal media of concern for MC residues at these sites. Ecological receptors will include terrestrial plants, soil invertebrates, and terrestrial wildlife. Plants and soil invertebrates are exposed to MC residues in both the surface (0 to 0.5 foot bgs) and subsurface (0.5 to 2 feet bgs) soils. Evaluated exposures in wildlife receptors will include direct ingestion of soil from the sites and indirect ingestion from consumption of contaminated food items at the sites. Other potential exposure pathways (dermal contact and inhalation of dust or vapors) are considered insignificant for wildlife. The wildlife receptors will include both mammalian and avian species representing three major trophic guilds—herbivores, insectivores, and predators. Where the potential migration of MC to aquatic habitats is evaluated, concentrations within surface water and sediment will be assessed with regard to potential risks to relevant wetland and aquatic species.

3.16.2.2 Data Compilation and Screening

3.16.2.2.1 Data used in the SLERAs for these sites will include soil (to 2 feet in depth), surface water, sediment, and shallow groundwater, if applicable and as available. The data will consist of historical data plus the data collected as identified in the RI WP for each specific MRS. Only MC will be included in this evaluation; therefore, the potential constituents at these sites are limited to metals and explosive residues (and their by-products) and perchlorate, if groundwater samples are collected. These data will be combined and compiled into medium-specific summary tables that will include (for each detected analyte) the frequency of detection, the range of detected concentrations, the range of reporting limits, and, if sufficient data are available, the 95 percent UCL of the mean and the basis of the UCL calculation as determined by the ProUCL version 4.1.01 software package (EPA, 2010b).

3.16.2.2.2 The information presented in the statistical summary tables will be the basis of the preliminary COPEC selection. The preliminary COPECs will be selected from the overall analyte list based on the following criteria:

1. The analyte was detected in at least one sample of an ecologically relevant medium at the site.
2. The analyte is not an identified nutrient (i.e., it is not one of the following: calcium, magnesium, potassium, or sodium).
3. The maximum analyte concentration exceeds the corresponding ecologically based screening criteria (e.g., EPA ecological soil screening level [Eco-SSLs]).

3.16.2.2.3 Analytes that do not meet any of the above criteria will be eliminated from further consideration as a COPEC for the medium in question. All others will be considered preliminary COPECs and will be retained for evaluation in the SLERA.

3.16.2.3 Assessment and Measurement Endpoints

3.16.2.3.1 Preliminary assessment and measurement endpoints for the MRSs are listed in Table 3.5. Assessment endpoints represent an explicit expression of the actual environmental values to be protected at the site. Measurement endpoints represent quantifiable ecological characteristics that can be measured, interpreted, and related to the valued ecological component(s) chosen as the assessment endpoints. The measurement endpoints were selected based on the expected species/community/habitat patterns across the site, the varying relationship to the COPEC concentrations, and considerations of the potential mechanisms of toxicity. For each measurement endpoint, there is an explicit relationship between it and the assessment endpoint (that is, value to be protected) to which it is linked. For the SLERA problem formulation, the assessment and measurement endpoints are considered preliminary, are broadly based, and are primarily targeted at the identification of COPECs that may pose risk to receptor groups (for example, terrestrial plants or insectivorous birds). In the BERA (if conducted), these endpoints would be refined to directly target specific resources that may be at risk.

3.16.2.4 Key Ecological Receptors

3.16.2.4.1 For each of the assessment and measurement endpoint pair, a key ecological receptor or receptor group (for example, terrestrial plants) is identified. Specific receptor species are selected to represent a group of species that fill a specific niche in the ecosystem (for example, the American robin to represent avian insectivores). The key receptors for each of the assessment and measurement endpoints in this SLERA are listed in Table 3.6. The criteria for the selection of representative wildlife receptor species include three factors: (1) they are known or suspected to occur in the local ecological communities and are species likely to be exposed to chemical concentrations in the exposure media, (2) they represent functional groups considered to be essential to, or indicative of, the normal functioning of the affected habitat, and (3) they may represent federal or state threatened or endangered species or other protected or valued species in the local ecosystem.

3.16.3 Ecological Effects Evaluation

3.16.3.1 The ecological effects evaluation entails a review of the ecotoxicological record for each of the COPECs and the identification of ecological screening levels (ESLs) or, if necessary, the development of toxicity reference values (TRVs) for the selected ecological receptors. Effects considered ecologically relevant for wildlife receptors are growth, reproduction, and survival. For plants, a 20 percent reduction in growth (as per Efroymson et al., 1997) is considered ecological relevant.

Media-specific ESLs will be derived from the following sources and databases:

- EPA Eco-SSL documents (EPA, 2005a-h, 2006, 2007a-d, and 2008);
- EPA regional screening levels (specifically, EPA Regions 4 and 5);
- ESLs developed by National Laboratories (specifically, Oak Ridge National Laboratory, Los Alamos National Laboratory, and Savannah River National Laboratory);
- National Recommended Water Quality Criteria;
- National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (Buchman, 2008); and
- Relevant state guidance and standards.

3.16.3.2 TRVs will be based on chronic no observed adverse effect level (NOAEL) or equivalent toxicological benchmark values. These will primarily be from accepted secondary literature sources that may include the following:

- EPA Eco-SSL documents (EPA, 2005a through 2005h, 2006, 2007a through 2007d, and 2008),
- Sample et al. (1996),
- U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) (USACHPPM, 2000, 2001a, b, and c, 2002, and 2005), and
- Talmage et al. (1999).

3.16.3.3 If no toxicity values are available for a particular compound, appropriate surrogate chemical chronic NOAELs will be used to develop TRVs. Surrogate chemicals will be selected based on structural chemistry.

3.16.3.4 When chronic NOAELs are not available, other endpoints, such as lowest observed adverse effect levels (LOAELs), may be used with appropriate and accepted uncertainty factors (UFs) applied. UFs will include 0.1 for LOAEL-to-NOAEL or subchronic-to-chronic exposure and 0.01 for median lethal dose (LD_{50})-to-chronic NOAEL. It should be noted that from an ecological standpoint, basing the TRV on a NOAEL may be unduly conservative because exceedance of a NOAEL does not necessarily imply an adverse effect to the receptor.

3.16.4 Exposure Estimation

3.16.4.1 The exposure estimation is the process of estimating the magnitude of potential exposures of the selected ecological receptors to COPECs present at the site in question. This includes the identification of EPCs of the COPECs in each relevant medium that are appropriate to the level of risk assessment being conducted. For the SLERA, the initial screening will be based on maximum measured concentrations. If sufficient data are available to calculate 95 percent UCLs (at least eight data points as per EPA 2010b), these values will be used as the EPCs for the refined (less conservative) evaluation of potential risk for discrete samples. For ISM results, the detected concentrations also may be compared to screening levels using a 95 percent UCL (see Section 3.15.2.2.5).

3.16.4.2 For plants and soil invertebrates, exposures will be based directly on the EPC of the medium to which they are most exposed. This EPC will be the maximum measured concentration in either the surface (0 to 0.5 foot bgs) or subsurface (0.5 to 2 feet bgs).

3.16.4.3 For wildlife receptors (birds and mammals), species-specific exposure will be estimated through dietary exposure models. In these species, the principal mechanism of exposure is ingestion, which includes the direct ingestion of the COPEC in incidentally ingested soil from the site and the indirect ingestion of the COPECs within the tissues of food items from the site. Although wildlife may also be exposed to site COPECs through dermal contact with soil or through the inhalation of dust or vapors, these are considered minor pathways with respect to the ingestion pathways and will not be explicitly evaluated.

3.16.4.4 Exposure of wildlife receptor species through ingestion is quantified as an ADD, which is in units of milligrams of the COPEC per kilogram (fresh) of body weight per day (mg/kg-day). The general equation used to calculate the receptor's ADD is as follows:

$$ADD_i = AUF_i \cdot SUF_i \left(\frac{SIR_i \cdot C_s + \sum_{j=1}^{n} \left(Fr_{ij} \cdot FIR_{ij} \cdot C_j \right)}{BW_i} \right)$$

Where:

ADD_i	=	Average daily dose for wildlife receptor species i (mg/kg-day)
AUF_i	=	Area use factor for wildlife receptor species i (unitless)
SUF_i	=	Seasonal use factor for wildlife receptor species i (unitless)
SIR_i	=	Daily incidental soil ingestion rate wildlife receptor species i (kg dw/day)
C_s	=	Concentration of COPEC in soil (mg/kg dw)
Fr_{ij}	=	Fraction of diet of wildlife receptor species i composed of food item j (unitless)
FIR_{ij}	=	Daily food ingestion rate of wildlife receptor species i (kg dw/day)
C_j	=	Concentration of COPEC in food item j (mg/kg dw)
n	=	The number of food items in the diet of wildlife receptor species i
BW	=	Body weight (kg fresh weight).

3.16.4.5 For the SLERA, both the area use factor and seasonal use factor (SUF) will be initially set to 1.0, meaning that the receptor is present and active throughout the year and its foraging activities are entirely restricted to the site. If it is found in the analysis of uncertainties that more realistic assumptions of area or seasonal use will significantly reduce the predicted risk for a particular receptor species, these factors may be altered accordingly in the refined assessment.

3.16.4.6 A preliminary list of terrestrial wildlife receptors and associated exposure factors for the SLERA is presented in Table 3.7. Values for the food ingestion rate (FIR), soil ingestion rate (SIR), and body weight for the wildlife receptors species are derived from literature sources where available (e.g., EPA, 1993). In some cases, these factors are estimated from body weight based on allometric equations. Allometric equations are generally of the form:

$$FIR = a \cdot BW^b$$

Where:

FIR	=	Food ingestion rate of the wildlife receptor (kg dw/day)
BW	=	Body weight of wildlife receptor species (kg)

a and b = Empirically derived regression parameters from the literature specific to a particular taxon or trophic level.

3.16.4.7 The dietary exposure model allows for multiple dietary items. For the SLERA, however, each receptor will be limited to a single food item based on the nominal trophic level of the species (see Table 3.7). Therefore, Fr_{ij} in the dietary exposure model will be 1.0 (100 percent) in all cases. Mixed diets may be evaluated in the refined evaluation of risk if this restrictive assumption is found to be producing unrealistic estimates of potential risk.

3.16.4.8 Because biotic tissues will not be directly sampled at any of the MRSs, the COPEC concentrations in the food items (Cj) will estimated from the media-specific concentrations using biota transfer models from the literature. These models may be simple linear models that incorporate a bioaccumulation factor or a similar media-to-biota transfer factor, or they may be empirically derived nonlinear models, typically based on a log-log regression model (e.g., Sample et al., 1998a, b). Sources of transfer factors in the literature are varied and include Baes et al. (1984), Bechtel Jacobs Company (1998), EPA (1999b and 2005a), and Talmage et al. (1999). For organic compounds, the transfer factors may be estimated from the octanol-water partition coefficient (log K_{ow}). Equations for these estimations are from sources such as EPA (1999b and 2005a), Travis and Arms (1988), and Garten and Trabalka (1983).

3.16.5 Risk Characterization

3.16.5.1 The risk characterization integrates the results of the exposure assessment and effects characterization into an estimation of the potential for adverse effects to site-specific ecological receptors. The risk characterization is the culmination of the preceding steps of the ERA and includes three principal components: (1) risk estimation, (2) risk description, and (3) uncertainty analysis. In the risk estimation, the potential for risk to the ecological receptors will be quantitatively estimated using the HQ method. In this method, the estimated exposure (as determined in the exposure assessment) is compared to the TRV (as determined in the effect characterization) using the following equation:

$$HQ = \frac{EPCorADD}{SLVorTRV}$$

Where:

HQ = hazard quotient (unitless)

EPC = exposure point concentration (mg/kg or mg/L)

ADD = average daily dose (mg/kg-day)

SLV = screening level value

TRV = toxicity reference value (same units as the numerator).

3.16.5.2 When the HQ is less than 1.0, the estimated potential exposure is less than the TRV, indicating with a high degree of confidence that a potential risk does not exist and that the COPEC can be eliminated from further consideration as a risk driver for that receptor or pathway. Compounds having an HQ greater than 1.0 indicate that a potential for risk may exist and further evaluation is necessary before a final conclusion can be reached regarding the potential for risk. In the risk description component, all of the exposure and risk estimates are synthesized and qualitatively interpreted. A weight-of-evidence evaluation may be included in this step to incorporate other lines of information in support of the conclusion of the risk description. Finally, in the uncertainty analysis, sources of uncertainty in the risk assessment process will be described and the probable effect of underlying assumptions on the predicted potential for risk will be addressed.

Based on the NCDENR (2003) guidelines, each COPEC will be categorized in accordance with the following criteria:

Category 1 – The maximum detection exceeds the media-specific ESL.
Category 2 – The laboratory practical quantition limit (PQL) exceeds the EPA Region 4 media-specific ESL.
Category 3 – The COPEC has no EPA Region 4 ESL, but was detected above the laboratory PQL.
Category 4 – The COPEC was not detected above the laboratory PQL and has no EPA Region 4 ESL.
Category 5 – The (water-based) COPEC has a PQL or maximum detection exceeds the North Carolina Surface Water Quality Standards.

3.16.6 Refined Risk Estimation

3.16.6.1 Because highly conservative assumptions and models will be used in the initial estimation of potential ecological risks, it is likely that the actual risk posed by site COPECs will be overestimated in the SLERA. For this reason, COPECs with HQs exceeding unity will be reevaluated based on less conservative assumptions of exposure and effects that are more likely to reflect actual site conditions and the receptor natural history. Among the factors that will be refined in this process are the assumed EPC (using a conservative estimate of the mean rather than the maximum), more realistic diets and FIRs (relative to body size), more realistic area and SUFs, and comparisons to background concentrations and background risk. In addition, any COPEC that was detected in 5 percent or fewer of the samples from a particular medium will be evaluated to determine whether the detections are indicative of a hot spot. If that is not the case, the COPEC will be eliminated from further consideration in the risk assessment process. The results of this reexamination will be used in the formulation of final recommendations for additional assessment at the sites.

3.17 MEC HAZARD ASSESSMENT

HGL will complete the MEC hazard assessment (HA) in accordance with the guidance provided in the MEC HA interim guidance document (EPA, 2008b). The MEC HA will be used to evaluate the potential for explosive safety hazards as a result of residual MEC presence that may be accessible to receptors. This interim guidance was developed by the Technical Working Group for Hazard

Assessment, which included representatives from the DoD, the U.S. Department of the Interior, the EPA, and various states and tribes. The DoD has encouraged the trial use of the method for a 2-year period (DoD, 2009). If MEC contamination is identified at the site, the MEC HA will be completed and documented in the RI report in future, to provide a qualitative assessment of the potential acute explosive hazards associated with MEC. The MEC HA will incorporate site-specific conditions and human issues that affect the likelihood that a MEC accident will occur. Subchapters 3.1 through 3.13 describe the data to be obtained and the methods for data collection in support of the MEC HA.

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TABLES

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Table 3.1
Remedial Investigation Approach

MRS	Investigation Approach	Rationale/Assumptions
Range Complex 1 (RC1) (12,363 acres)	***Mapping and Surveying:*** • Identify properties where ROEs have been granted. Clear undergrowth in the areas of grids that will be surveyed during the RI. Conduct all fieldwork with properly trained UXO personnel. • Conduct surface clearance including site preparation and visual inspection of surface and aboveground locations for MEC or MD. • Define grid boundaries using nonmetallic stakes. • If additional evidence is found that suggests that the area impacted by historical operations of the MRS may be larger or smaller, modify MRS boundaries to improve boundary accuracy. Coordinate with PDT to expand investigation to increase confidence that the MEC use boundary is defined.	Provide proper access to MRS, define site conditions and boundaries, and identify safety concerns.
	Geophysical Verification: • Conduct DGM geophysical transect survey of 110 miles of 3-foot-wide strips (40.0 acres) using the Geonics EM61-MK2 and WAAS, PPK, or RTK GPS in MEC use areas. • Conduct DGM geophysical surveys to evaluate approximately 139 (50- by 50-foot) grids, approximately 8.0 acres, using an EM61-MK2 in MEC use areas. • Conduct DGM geophysical surveys to evaluate approximately 19 (50- by 50 foot) grids, approximately 1.1 acres, using an EM61-MK2 in satellite historical use areas. • Conduct surface reconnaissance of 67 miles of 3-foot-wide transects (approximately 24.4 acres) using a Schonstedt magnetometer in non-MEC use areas. • Process geophysical data collected using Geosoft Oasis Montaj and UX-Detect modules, generate anomaly density maps and prioritized target lists, and document MD, CD and MEC.	Conduct DGM geophysical evaluation using transects and grids over MRS. Identify potential subsurface anomalies associated with former activities and provide data to characterize the nature (type) and extent (vertical and areal distribution) of munitions material (MEC/MPPEH/MC). Generate site map showing the distribution and density of anomalies. VSP and UXO Estimator will be used to statistically show that areas have been characterized to the PWS-required confidence.
	Reacquisition of Anomalies: • Select and intrusively investigate MEC-like targets within grids. • Utilize an MEC team under the direct supervision of the SUXOS to evaluate identified anomalies. (All UXO personnel will meet the minimum qualifications outlined in the DDESB TP-18.)	Evaluate identified geophysical anomalies and remove items of concern. Identify locations of supplemental incremental sampling units.
	MC ISM, Discrete Soil, and Sediment Sampling: • Select ten 100- by 100-foot IS sampling unit parcels based on results of the geophysical survey. • Subdivide each sampling unit into 32 uniform (incremental sample) grid cells. • Randomly select a single increment sampling point in an initial grid cell (center of grid) and collect increments from the same relative location within each of the other grid cells. • Analyze ISM soil samples for explosives (8330B) and metals (6020A - copper, lead, antimony, and zinc). • If IS sample results require, collect additional IS samples and/or up to 10 surface and shallow subsurface soil samples (<2 feet bgs) from within the general area sampled during the IS phase. • If IS sample results require, select up to ten sediment sampling locations based on IS sample results and PDT input. • Collect up to ten sediment samples from selected surface water locations (creeks, ponds, lakes etc). • Analyze sediment samples for explosives (8330B) and select metals (6020A - copper, lead, antimony, and zinc)	Determine the concentration and distribution of explosives and metals in the surface soil throughout the MRS and at historical areas of concern. Provide data to determine MC concentrations. Provide sufficient data to evaluate site-specific leaching characteristics, soil to groundwater migration pathways. Determine if potential site related surface soil constituents have migrated to adjacent surface water bodies and impacted sediment.

Table 3.1 (continued)
Remedial Investigation Approach

MRS	Investigation Approach	Rationale/Assumptions
Range Complex 2 (RC1) (11,529 acres)	***Mapping and Surveying:*** • Identify properties where ROEs have been granted. Clear undergrowth in the areas of grids that will be surveyed during the RI. Conduct all fieldwork with properly trained UXO personnel. • Conduct surface clearance including site preparation and visual inspection of surface and aboveground locations for MEC or MD. • Define grid boundaries using nonmetallic stakes. • If additional evidence is found that suggests that the area impacted by historical operations of the MRS may be larger or smaller, modify MRS boundaries to improve boundary accuracy. Coordinate with PDT to expand investigation to increase confidence that the boundary of MEC is defined.	Provide proper access to MRS, define site conditions and boundaries, and identify safety concerns.
	Geophysical Verification: • Conduct DGM geophysical transect survey of 98 miles of 3-foot-wide strips (35.6 acres) using the Geonics EM61-MK2 and WAAS, PPK, or RTK GPS in MEC use areas. • Conduct DGM geophysical survey to evaluate approximately 124 (50- by 50-foot) grids, approximately 7.1 acres, using an EM61-MK2 in MEC use areas. • Conduct DGM geophysical surveys to evaluate approximately 9 (50- by 50-foot) grids, approximately 0.5 acres, using an EM61-MK2 in satellite historical use areas. • Conduct surface reconnaissance of 85 miles of 3-foot-wide transects (approximately 30.9 acres) using a Schonstedt magnetometer in non-MEC use areas. • Process geophysical data collected using Geosoft Oasis Montaj and UX-Detect modules, generate anomaly density maps and prioritized target lists, and document MD, CD and MEC..	Conduct DGM geophysical evaluation using transects and grids over MRS. Identify potential subsurface anomalies associated with former activities and provide data to characterize the nature (type) and extent (vertical and areal distribution) of munitions material (MEC/MPPEH/MC). Generate site map showing the distribution and density of anomalies. VSP and UXO Estimator will be used to statistically show that areas have been characterized to the PWS-required confidence.
	Reacquisition of Anomalies: • Select and intrusively investigate MEC-like targets within grids. • Utilize an MEC team under the direct supervision of the SUXOS to evaluate identified anomalies. (All UXO personnel will meet the minimum qualifications outlined in the DDESB TP-18.)	Evaluate identified geophysical anomalies and remove items of concern. Identify locations of supplemental incremental sampling units.
	MC ISM, Discrete Soil, and Sediment Sampling: • Select ten 100- by 100-foot IS sampling unit parcels based on results of the geophysical survey. • Subdivide each sampling unit into 32 uniform (incremental sample) grid cells. • Randomly select a single increment sampling point in an initial grid cell (center of grid) and collect increments from the same relative location within each of the other grid cells. • Analyze ISM soil samples for explosives (8330B), and metals (6020A - copper, lead, antimony, and zinc). • If IS sample results require, collect additional IS samples and/or up to 10 surface and shallow subsurface soil samples (<2 feet bgs) from within the general area sampled during the IS phase. • If IS sample results require, select up to ten sediment sampling locations based on IS sample results and PDT input. • Collect up to ten sediment samples from selected surface water locations (creeks, ponds, lakes etc). • Analyze sediment samples for explosives (8330B) and select metals (6020A - copper, lead, antimony, and zinc)	Determine the concentration and distribution of explosives and metals in the surface soil throughout the MRS and at historical areas of concern. Provide data to determine MC concentrations. Provide sufficient data to evaluate site-specific leaching characteristics and soil to groundwater migration pathways. Determine if potential site related surface soil constituents have migrated to adjacent surface water bodies and impacted sediment.

Table 3.1 (continued)
Remedial Investigation Approach

MRS	Investigation Approach	Rationale/Assumptions
ARNG Property (4,824 acres)	***Mapping and Surveying:*** • Identify properties where ROEs have been granted. Clear undergrowth in the areas of grids that will be surveyed during the RI. Conduct all fieldwork with properly trained UXO personnel. • Conduct surface clearance including site preparation and visual inspection of surface and aboveground locations for MEC or MD. • Define grid boundaries using non-metallic stakes. • If additional evidence is found that suggests that the area impacted by historical operations of the MRS may be larger or smaller, modify MRS boundaries to improve boundary accuracy. Coordinate with PDT to expand investigation to increase confidence that the boundary of MEC is defined.	Provide proper access to MRS, define site conditions and boundaries, and identify safety concerns.
	Geophysical Verification: • Conduct DGM geophysical transect survey of 52 miles of 3-foot-wide (18.9 acres) using the Geonics EM61-MK2 and WAAS, PPK, or RTK GPS in MEC use areas. • Conduct DGM geophysical survey to evaluate approximately 66 (50- by 50-foot) grids, approximately 3.8 acres, using an EM61-MK2 in MEC use areas. • Conduct DGM geophysical surveys to evaluate approximately 11 (50-by 50-foot) grids, approximately 0.6 acres, using an EM61-MK2 in satellite historical use areas. • Conduct surface reconnaissance of 29 miles of 3-foot-wide transects (approximately 10.5 acres) using a Schonstedt magnetometer in non-MEC use areas. • Process geophysical data collected using Geosoft Oasis Montaj and UX-Detect modules, generate anomaly density maps and prioritized target lists, and document MD, CD and MEC.	Conduct DGM geophysical evaluation using transects and grids over MRS. Identify potential subsurface anomalies associated with former activities and provide data to characterize the nature (type) and extent (vertical and areal distribution) of munitions material (MEC/MPPEH/MC). Generate site map showing the distribution and density of anomalies. VSP and UXO Estimator will be used to statistically show that areas have been characterized to the PWS-required confidence.
	Reacquisition of Anomalies: • Select and intrusively investigate MEC-like targets within grids. • Utilize an MEC team under the direct supervision of the SUXOS to evaluate identified anomalies. (All UXO personnel will meet the minimum qualifications outlined in the DDESB TP-18.)	Evaluate identified geophysical anomalies and remove items of concern. Identify locations of supplemental incremental sampling units.
	MC ISM, Discrete Soil, and Sediment Sampling: • Select ten 100-by 100-foot IS sampling unit parcels based on results of the geophysical survey. • Subdivide each sampling unit into 32 uniform (incremental sample) grid cells. • Randomly select a single increment sampling point in an initial grid cell (center of grid) and collect increments from the same relative location within each of the other grid cells. • Analyze ISM soil samples for explosives (8330B), and metals (6020A - copper, lead, antimony, and zinc). • If IS sample results require, collect additional IS samples and/or up to 10 shallow subsurface soil samples (<2 feet bgs) from within the general area sampled during the IS phase. • If IS sample results require, select up to ten sediment sampling locations based on IS sample results and PDT input. • Collect up to ten sediment samples from selected surface water locations (creeks, ponds, lakes etc). • Analyze sediment samples for explosives (8330B) and select metals (6020A - copper, lead, antimony, and zinc)	Determine the concentration and distribution of explosives and metals in the surface soil throughout the MRS and at historical areas of concern. Provide data to determine MC concentrations. Provide sufficient data to evaluate site-specific leaching characteristics and soil to groundwater migration pathways. Determine if potential site related surface soil constituents have migrated to adjacent surface water bodies and impacted sediment.

Table 3.1 (continued)
Remedial Investigation Approach

Background	Investigation Approach	Rationale/Assumptions
Background Soil	***MC Background Soil Sampling:*** • Select ten 100- by 100-foot IS sampling unit parcels based on evaluation of background characteristics. • Subdivide each sampling unit into 32 uniform (incremental sample) grid cells. • Randomly select a single increment sampling point in an initial grid cell (center of grid) and collect increments from the same relative location within each of the other grid cells. • Analyze ISM soil samples for metals (6020A - copper, lead, antimony, and zinc).	Determine the concentration and distribution of background metals in the surface soil as described in Section 3.3.5. Utilize background data set during the assessment of site-related contamination (including risk assessments) to ensure that naturally occurring and non-site related constituents are not unnecessarily carried forward through the assessments.
Background Groundwater	***MC Background Groundwater Sampling:*** • Select up to ten existing wells for groundwater sampling based on PDT input. • Collect up to ten groundwater samples from existing production well locations. • Analyze groundwater samples for lead (6020A) and perchlorate (6850).	Determine if past perchlorate and lead detections are attributable to sources other than MC and confirm previous investigation results.

Table 3.2
Geophysical Survey Approach

MRS	Transect Distance (miles)	Reconnaissance Survey Distance (miles)	Number of Grids in MEC Use Area (50H50-foot)	Number of Grids in Satellite Historical Use Areas (50H50-foot)
RC1	110.0	67.0	139	19
RC2	98.0	85.0	124	9
ARNG	52.0	29.0	66	11
Totals	260.0	181.0	329	39

Table 3.3
Instrument Verification Strip Target Line Layout

Target ID	Target Cylinder	Orientation	Depth Below Ground Surface (meters)	Predicted EM61 MK2 Channel 3 Response (mV)
IVS1	1 ID inch H 4 inches	Transverse to transect	0.0	10.9
IVS2	2 ID inches H 8 inches	Transverse to transect	0.0	121.4
IVS3	1 ID inch H 4 inches	Transverse to transect	0.1	5.2
IVS4	2 ID inches H 8 inches	Transverse to transect	0.2	29.0
IVS5	1 ID inch H 4 inches	Transverse to transect	0.2	2.6
IVS6	2 ID inches H 8 inches	Transverse to transect	0.4	8.4

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Table 3.4
Sample Matrix

Matrix	Estimated No. Field Samples Required	QC Field Duplicates or Triplicates/ Splits (10%) (A)	Matrix Spikes (5%)/Matrix Spike Duplicates (5%) (B)	Equipment Rinsate Blanks (10%)	QA Field Dup/ Splits (10%)	Total HGL Samples	Analysis	Analytical Procedures	DQO Level	Holding Time	Preservation Requirements	Sample Containers
Incremental Soil Sampling (MRS)	**30**	6		Rinsate Sample Below	NA	**38**	**Multi-Increment** Explosives (including PETN and Nitroglycerin)	8330B	Definitive	14 days for extraction/ 40 days for analysis	Cool to 4°C	Clear polyethylene bag, containing 32 aliquots, total sample weight of approximately 1.5 kilograms. ***Metals sample aliquot collected at laboratory prior to sample grinding.***
	30	6		Rinsate Sample Below	NA	**37**	**Multi-Increment** Metals (copper, lead, antimony and zinc)	6020A	Definitive	180 days	Cool to 4°C	Clear polyethylene bag, containing 32 aliquots, total sample weight of approximately 1.5 kilograms. ***Metals sample aliquot collected at laboratory prior to sample grinding.***
Incremental Soil Sampling (Background)	10	2		Rinsate Sample Below	NA	**13**	**Multi-Increment** Metals (copper, lead, antimony and zinc)	6020A	Definitive	180 days	Cool to 4°C	Clear polyethylene bag, containing 32 aliquots, total sample weight of approximately 1.5 kilograms. ***Metals sample aliquot collected at laboratory; no sample grinding.***
Discrete Soil Sampling	**30**	3	2	Rinsate Sample Below	3	**38**	**Explosives** (including PETN and Nitroglycerin)	8330A	Definitive	14 days for extraction/40 days for analysis	Cool to 4°C	(1) 8-ounce wide-mouth glass with Teflon-lined cap
	30	3	2	Rinsate Sample Below	3	**38**	Metals (copper, lead, antimony and zinc)	6010B	Definitive	180 days	Cool to 4°C	(1) 8-ounce wide-mouth glass with Teflon-lined cap

Table 3.4 (continued)
Sample Matrix

Matrix	Estimated No. Field Samples Required	QC Field Dup/Splits (10%) (A)	Matrix Spikes (5%)/ Matrix Spike Duplicates (5%) (B)	Equipment Rinsate Blanks (10%)	QA Field Dup/ Splits (10%)	Total HGL Samples	Analysis	Analytical Procedures	DQO Level	Holding Time	Preservation Requirements	Sample Containers (bottles per sample)
Sediment Sampling	**30**	3	2	Rinsate Sample Below	3	**38**	**Explosives** (including PETN and Nitroglycerin)	8330B	Definitive	14 days for extraction/ 40 days for analysis	Cool to 4°C	(1) 8-ounce wide-mouth glass with teflon lined cap
	30	3	2	Rinsate Sample Below	3	**38**	**Total Metals** (copper, lead, antimony and zinc)	6020A	Definitive	180 days	Cool to 4°C	(1) 8-ounce wide-mouth glass with Teflon-lined cap
Groundwater Sampling (existing wells)	**10**	1	2	0	1	**14**	**Total Metals** (lead)	6020A	Definitive	180 days	Cool to 4°C pH <2	(1) 1 liter polyethylene preserved with HNO3 to pH <2
	10	1	2	1	1	**15**	**Background for total metals (lead)**	6020A	Definitive	180 days	Cool to 4°C pH <2	(1) 1 liter polyethylene preserved with HNO3 to pH <2
	10	1	2	0	1	**14**	**Perchorate (6850)**	6850	Definitive	28 days	Cool ≤6°C	125 mL polyethylene bottle

(A) For incremental sampling, triplicate QC sampling is conducted at a rate of 10 percent. One IS sampling unit collected in triplicate equates to three field samples. Per Method 8330B, percent relative standard deviation calculations of triplicate samples serve as QA/QC measures (typically, relative standard deviation should be <30 percent).
(B) Matrix spike/matrix spike duplicate analyses will not require the submission of triplicate aliquots; a single incremental sample will contain sufficient material to perform any required QC analyses in conjunction with the sample analyses.

Table 3.5
Assessment and Measurement Endpoints, Screening-level Ecological Risk Assessment
Munitions Response Sites, Camp Butner, North Carolina

Assessment Endpoint	Measurement Endpoint	Key Ecological Receptor(s)
Growth, reproduction, and survival of terrestrial plant populations	Comparison of MC concentrations in surface and subsurface soil to plant-based soil screening levels.	Terrestrial plants (generic)
Growth, reproduction, and survival of soil invertebrate populations	Comparison of MC concentrations in surface and subsurface soil to earthworm-based soil screening levels.	Earthworms
Growth, reproduction, and survival of herbivorous wildlife populations	Comparison of estimated ADDs for MC in soil to established avian and mammalian toxicity reference values (NOAELs) for growth, reproduction, and survival.	Mourning dove (bird) Eastern cottontail (mammal)
Growth, reproduction, and survival of insectivorous wildlife populations	Comparison of estimated ADDs for MC in soil to established avian and mammalian toxicity reference values (NOAELs) for growth, reproduction, and survival.	American woodcock (bird) Southern short-tailed shrew (mammal)
Growth, reproduction, or survival of carnivorous wildlife populations	Comparison of estimated ADDs for MC in soil to established avian and mammalian toxicity reference values (NOAELs) for growth, reproduction, and survival.	Red-tailed hawk (bird) Long-tailed weasel (mammal)
The following are contingent upon COPECs being identified in surface water or sediment media		
Growth, reproduction, and survival of wetland plant populations	Comparison of MC concentrations in sediment to plant-based soil screening levels.	Wetland plants (generic)
Growth, reproduction, and survival of benthic invertebrate populations	Comparison of MC concentrations in sediment to sediment-based ecological screening levels.	Benthic invertebrates (generic)
Growth, reproduction, and survival of aquatic populations	Comparison of MC concentrations in surface water to water-based ecological screening levels and water quality criteria.	Aquatic receptors (generic)
Growth, reproduction, and survival of wetland wildlife populations	Comparison of estimated ADDs for MC in sediment and/or water to established avian and mammalian toxicity reference values (NOAELs) for growth, reproduction, and survival.	mallard (bird) raccoon (mammal)

ADD = average daily dose
MC = munitions constituents
NOAEL = no observed adverse effect level

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Table 3.6
Exposure Factors for Terrestrial Wildlife Receptors Munitions Response Sites, Camp Butner, North Carolina

Common Name	Scientific Name	Trophic Level[1]	Body Weight[2] (kg)	Food Ingestion Rate (FIR)[3] (kg[dw]/day)	Soil Ingestion Rate[4] (percent of FIR)	Home Range[5] (acres)
Mourning dove	*Zenaida macroura*	Herbivore	0.115	0.0219	13.9	28.3
American woodcock	*Scolopax minor*	Insectivore	0.176	0.0377	16.4	11.1
Red-tailed hawk	*Buteo jamaicensis*	Carnivore	1.03	0.0364	5.7	941
Eastern cottontail	*Sylvilagus floridanus*	Herbivore	1.11	0.0944	6.3	7.23
Southern short-tailed shrew	*Blarina carolinensis*	Insectivore	0.0050	0.00105	3.0	0.963
Long-tailed weasel	*Mustela frenata*	Carnivore	0.085	0.0111	4.3	6.68

[1]In the SLERA, trophic level will determine the diet of the receptor: herbivore = diet of plant material; insectivore = diet of earthworms; carnivore = diet of small mammals. Mixed diets will not be evaluated at the screening level.
[2]Body weights are from Dunning (1993) and Silva and Downing (1995).
[3]Food ingestion rates based on data for equivalent species used by EPA to derive Eco-SSLs (EPA, 2005a) or, in the case of the eastern cottontail, on the allometric equation for mammalian herbivores presented in EPA (1993).
[4]Soil ingestion rates based on on data for equivalent species used by EPA to derive Eco-SSLs (EPA, 2005a) or, in the case of the eastern cottontail, on data presented in EPA (1993) for jackrabbits.
[5]Home ranges for American woodcock, red-tailed hawk, eastern cottontail, and southern short-tailed shrew from data in EPA (1993). Home range for mourning dove and long-tailed weasel based on allometric equations from Schoener (1968) and Jetz et al. (2004), respectively.

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Table 3.7
Site-Specific Data Quality Objective Summary for Munitions Response Sites ARNG, Range Complex 1 and Range Complex 2
Camp Butner, North Carolina

Criteria from USEPA [1]	Problem Statement / Problem Goals	Required Information Inputs			Input Boundaries	Analytical Approach	Performance Criteria	Plan for Obtaining Data	
Criteria from USACE	**Project Objectives Satisfied**	**Data User Perspectives**	**Contaminant or Characteristic of Interest**	**Media of Interest**	**Required Locations or Areas**	**Number of Samples Required**	**Reference Concentration of Interest or Other Performance Criteria**	**Sampling Method**	**Analytical Method**
UXO Characterization	Evaluate the nature and extent of UXO contamination and determine if further response actions are required to support current and future residential, commercial, agricultural, ARNG training, and recreational land use.[2]	Risk, Remedy	UXO, Munitions Debris distribution/density	Surface and Subsurface soil	**ARNG** (4,824 acres) Anticipated munitions types: small arms, 2.36-inch rockets; rifle grenades; 37mm, 57mm, 105mm, and 155mm projectiles; also 60mm and 81mm mortars based on information from the National Guard and the ASR. **RC 1** (12,363 acres) and **RC 2** (11,529 acres) (Focus on areas not previously characterized in both range complexes.) Anticipated munitions types include 37mm, 40mm, 57mm, 105mm, 155mm, and 240mm projectiles; 60mm and 81mm mortars; 2.36-inch rockets, and hand and rifle grenades.	Surface clearance, DGM surveys (transects and grids), surface reconnaissance, and intrusive investigations. See Remedial Investigation Approach detailed in Tables 3.1 and 3.2	All investigations shall be conducted in accordance with the performance and data quality metrics outline in the QCP (Chapter 4). The investigation set out in Table 3.1 and Figures 3.1, 3.2, and 3.3 will meet the performance standards of the PWS: • all areas with elevated anomaly density or with potential to contain UXO are traversed and that there is a 90% chance of detecting these areas; • the boundaries of all identified UXO contaminated areas have been delineated to an accuracy of at least 250 feet; • 90% confidence has been achieved for determining the potential depth of UXO; • 90% confidence in the nature (type and density) of UXO and munitions related debris, for each relatively homogeneous UXO contaminated area, has been achieved; • portions of an MRS which are unlikely to contain UXO contamination may be omitted from the above statistical requirements; and • Demonstrate areas unlikely to contain a target with elevated anomaly density, but with the potential for UXO contamination (e.g. burial pits) are capable of being located by the investigation approach.	Following surface clearance and DGM surveys, areas will be delineated into “elevated anomaly density” areas and areas unlikely to contain UXO contamination. The intrusive investigations will be placed accordingly based on the performance criteria and decision rule applied (see paragraph 3.5). Evaluations of the presence of MD, frag, and known high density anomaly areas will be used to indicate the likelihood of UXO contamination.	Not applicable.

Table 3.7 (continued)
Site-Specific Data Quality Objective Summary for Munitions Response Sites ARNG, Range Complex 1 and Range Complex 2 Camp Butner, North Carolina

Criteria from USEPA (1)	Problem Statement / Problem Goals	Required Information Inputs			Input Boundaries	Analytical Approach	Performance Criteria	Plan for Obtaining Data	
Criteria from USACE	**Project Objectives Satisfied**	**Data User Perspectives**	**Contaminant or Characteristic of Interest**	**Media of Interest**	**Required Locations or Areas**	**Number of Samples Required**	**Reference Concentration of Interest or Other Performance Criteria**	**Sampling Method**	**Analytical Method**
MC Characterization	Evaluate and determine nature and extent of MC contamination (3)	Risk, Remedy	MC (as set out in "Analysis" shown in Table 3.5) to include: Explosives, metals (copper, lead, antimony and zinc) analysis for soil and sediment and Total lead and perchlorate analysis for groundwater.	Soil, sediment, and groundwater	MRSs: ARNG (4,824 acres) RC 1 (12,363 acres) RC 2 (11,529 acres) Incremental sampling (IS) will be conducted at locations selected based on historical information, DGM data, and intrusive investigative results.	Ten IS surface soil samples will be collected in each MRS. See Remedial Investigation Approach detailed in Table 3.1 and the Sampling Matrix provided in Table 3.5	If MC is detected, results will be compared against site-specific background levels and screening levels to determine if MC contamination is present. The screening levels as developed during the TPP process are set out in the Appendix E (UFP-QAPP) worksheets Site-specific background samples will be used to assess metals concentrations. Based on evaluation of the IS sample results, shallow subsurface soil samples will be collected. Up to ten sediment samples will be collected at each MRS. Ten groundwater samples will be collected at offsite locations for establishing background.	Includes collection of incremental soil samples, discrete shallow subsurface soil samples, and groundwater samples. Samples to be collected and analyzed in accordance with Section 3.3 and Appendix E of this work plan and to meet all quality requirements of the QCP, Chapter 4.	IS will be analyzed for explosives (8330B) and select metals (6010C). Analysis of discrete samples will include explosives (8330A), select metals (6010C) and perchlorate (6850). See additional Sampling Matrix Table 3.5.

(1) This table provides a summary of the DQO development conducted during the TPP process (see Appendix H) and presents an overview of the DQO statements developed. This table provides a cross walk for each DQO element to the development steps from both the USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process* USEPA, EPA QA/G-4, EPA/240/B-06/001, February 2006, and USACE's *Technical Project Planning Process*, EM 200-1-2, 31 August 1998. The data collected under the DQOs summarized in here will be continuously evaluated during field investigations against the appropriate decision rules shown in Table 3.9.

(2) For the RI/FS the preliminary remediation objective for UXO is based on limiting interaction between any residual UXO and any receptors accessing the site and is anticipated to be either removal of any UXO present to a depth at which they no longer present a hazard to the anticipated human receptors, or to implement land use controls that will minimize the possibility of receptors coming into contact with UXO at the site. The term UXO is utilized within Tables 3.8 and 3.9 since site histories indicate that DMM is not likely to be present. If during completion of the RI field activities, DMM is identified, Tables 3.8 and 3.9 will be modified to address concerns associated with DMM.

(3) For the RI/FS the preliminary remediation objective for MC is based on the screening levels agreed to by the TPP Team as being protective of the identified exposure pathways shown in the CSM. The preliminary remediation objective is to ensure that any identified MC contamination at the site determined to pose an unacceptable risk to human health or the environment is addressed to minimize or mitigate those risks.

Table 3.8
Decision Rules for Munitions Response Sites ARNG, Range Complex 1 and Range Complex 2
Camp Butner, North Carolina

	Characterization (UXO/MC) and Preliminary Status	Investigation	Decision Rule	Intermediate Status	Decision Rule	Intermediate Status	Decision Rule	Final Status and Recommendation
1	UXO Characterization where UXO **contamination** is anticipated	Per Table 3.1: Conduct surface clearance mapping and surveying (visual inspection of surface and aboveground locations for UXO or MD).	If UXO and MD are located: Modify MRS boundaries to improve boundary accuracy. Expand investigations (if needed).	**UXO contamination** is anticipated	Following completion of geophysical surveys the area will be identified as: 1) an area having **elevated anomaly density** or the potential to contain UXO or; 2) areas **unlikely to contain UXO contamination**.	**1) Elevated Anomaly Density:** Demonstrate that a 90% confidence has been achieved for determining both the potential depth of UXO and the nature (type and density) of UXO	**UXO Contaminated:** Following intrusive investigation, if UXO or a significant amount of MD are found, the area will be characterized as UXO **contaminated**.	**UXO Contaminated** - Recommended for evaluation in FS
						2) **Unlikely to Contain UXO Contamination**: Demonstrate that the investigation approach was capable of locating potential UXO contamination	**Unlikely to Contain UXO Contamination:** If no MEC or MD are found, the area will be characterized as. **No Significant UXO Present**	**No significant UXO present –** No FS evaluation required, potential for NDAI
2	UXO characterization where **No UXO contamination anticipated**(1)	Conduct surface reconnaissance using a Schonstedt magnetometer in non-MEC use areas.	If UXO and MD are located: Modify MRS boundaries to improve boundary accuracy. Expand investigations (if needed).	**UXO contamination**	If UXO contamination is anticipated, the decision rules in Row 1 will apply			
				Unlikely to contain UXO contamination	If no UXO or MD are found, the area will be characterized as. **No significant UXO present**	**No significant UXO present –** Recommended for NDAI		
3	MC Characterization	Sampling as outlined in Table 3.1	MC is not detected or concentrations are less than screening levels and/or background (as defined in the UFP-QAPP, Appendix E)	**No MC Contamination** Recommended for NDAI				
			MC are detected at concentrations exceeding the screening levels and/or background	**MC contamination is present**	If MC contamination is present, additional evaluation of the nature and extent (soil sampling and/or a risk assessment) will be conducted	**MC contamination** Recommended for FS		

(1) Areas where no UXO contamination is anticipated from historical data or observed site conditions are omitted from the statistical requirements of the PWS Section 3.4.6 performance standards. The term UXO is utilized within Tables 3.8 and 3.9 since site histories indicate that DMM is not likely to be present. If during completion of the RI field activities, DMM is identified, the project development team will discuss the planned technical approach and Tables 3.8 and 3.9 will be modified to address concerns associated with DMM.

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4.0 QUALITY CONTROL PLAN

4.0.1 The following subsections define the QC process and procedures that will be used during the RI/FS at Camp Butner. Additional details of the QC procedures as they apply to the Camp Butner RI/FS are contained in the project Quality Assurance and Surveillance Plan (QASP).

4.1 STANDARD QUALITY CONTROL PROCESS

4.1.1 It is HGL's policy to apply sound and cost-effective quality principles to all of its activities. This policy assists in ensuring the proper execution of work, the management of liability, and the maintenance of HGL's professional reputation for excellence. The QC policies and procedures are applicable to all participating project personnel and subcontractors, and to all site activities affecting quality including, but not limited to, MEC investigation and operations, and data management. Regardless of subcontractor or teaming agreements, HGL is solely responsible for the control of quality and for providing services and deliverables that conform to contractual requirements.

4.1.2 The QC procedures were developed to identify and implement quality requirements to ensure that overall project activities are accomplished using an acceptable level of internal controls and review procedures. The purpose of such controls is to eliminate conflicts, errors, and omissions and ensure the technical accuracy of all deliverables. To provide these results, HGL will implement a Three Phase QC Process during execution of the Camp Butner RI/FS.

4.2 THREE-PHASE QC PROCESS

4.2.1 HGL will ensure that the three-phase QC system is implemented. This process consists of Preparatory, Initial, and Follow-up phases for each definable feature of work (DFOW). Each QC phase is important for obtaining a quality product; the preparation and initiation phases will be particularly invaluable in preventing QC problems. The phases are intended to ensure that DFOWs are completed in accordance with PWS requirements and applicable standards. A DFOW is an activity that is separate and distinct from other activities, has separate control requirements, and may be identified by different trades and disciplines. The following DFOWs have been identified for the project:

- Projects planning and submittals
- Mobilization
- Site Preparation
- Instrument-Aided Visual Surveys and Mag and Flag Operations
- Digital Geophysical Mapping (DGM) Operations
- Anomaly Avoidance, Removal and Disposal
- MC Sampling
- Demobilization

4.2.2 Although every member of the HGL team is responsible for quality workmanship, the UXOQCS for the project has the overall responsibility for the quality of the fieldwork and ensuring that the three-phase QC system is implemented in the field. The HGL PM has the responsibility for the quality of the deliverables developed for the project. The quality requirements associated with the RI field activities and the three-phase QC process are defined in Table 4.1.

4.3 PREPARATORY PHASE

4.3.1 The preparation phase will be completed prior to initiation of each DFOW. A meeting will be scheduled in advance of the work activity, if necessary, to ensure that there is sufficient time for any necessary corrective actions. The following will be completed during this phase:

- Review specifications, references, and plans;
- Check field equipment, ensure it is appropriate for intended use and has been tested, submitted, and approved;
- Assign responsibilities and ensure field staff have necessary knowledge, training, expertise, and information to perform jobs;
- Verify arrangements for support services;
- Inspect work area to verify required preliminary work has been completed;
- Review appropriate activity hazard analysis (AHA); and
- Ensure applicable process and procedures have been approved by the contracts officer.

4.3.2 HGL forms associated with the completion of the preparatory phase activities are presented in Appendix F or in the QASP.

4.3.3 WP and operating procedures will be reviewed by the UXOQCS during this phase to ensure that they describe the prequalifying requirements or conditions, equipment, materials, methodology, and QC provisions. Discrepancies between existing conditions and approved plans and procedures will be resolved or corrective actions will be taken for unsatisfactory and nonconforming conditions identified during a preparatory phase inspection. This will be verified by the UXOQCS or his designee before granting approval for work to begin.

4.3.4 The UXOSO will review the APP (Appendix D) and the appropriate AHAs to ensure that applicable safety requirements have been achieved. Preparation phase inspection results will be documented using the Preparatory Phase Checklist and will be summarized in the DQCR. The personnel qualifications checklist will be used to ensure that personnel meet or exceed the training standards outlined by DoD, USACE, and OSHA, including applicable hazardous waste operator training. HGL forms and checklists associated with the completion of the preparatory phase activities are presented in Appendix F.

4.4 INITIAL PHASE

4.4.1 This phase will be performed when the fieldwork has been initiated for a given DFOW. The purpose of this phase will be to accomplish the following:

- Inspect the work in progress for compliance with QC requirements,
- Verify adequacy of QC controls to ensure full contract compliance,
- Establish an acceptable level of workmanship,
- Verify that documentation related to field activities is complete,
- Verify that required PPE and other safety procedures are in compliance with the QC specifications contained in the APP and AHA, and
- Resolve differences of interpretation that may affect the quality of work.

4.4.2 Additional preparatory and initial phases may be conducted on the same work being performed if (1) the quality of ongoing work is unacceptable, (2) there are changes in the on-site production supervision or work crew, (3) work is resumed after a substantial period of inactivity (2 weeks or more), or (4) other problems develop.

4.4.3 The UXOQCS or designee will be responsible for ensuring that all discrepancies between site practices and approved plan specifications are identified, documented, and resolved. Corrective actions for unsatisfactory conditions or practices will be verified by the UXOQCS or his designee before granting approval to proceed. Initial phase results will be documented on the Initial Phase Checklist and summarized in the DQCR. A copy of HGL Form 15.11, Initial Phase Checklist, is included in Appendix F.

4.5 FOLLOW-UP PHASE

4.5.1 This phase will be conducted for each DFOW until it has been completed. The purpose of this phase is to ensure compliance with contract requirements and will include:

- Verify that the work has been completed in compliance with contract requirements and applicable standards;
- Ensure that the quality of workmanship was maintained and achieved;
- Validate all fieldwork to ensure that no data gaps exist and schedule additional field activities to address any existing data gaps;
- Verify analytical work was performed by the approved laboratory; and
- Verify that safety inspections were performed.

4.5.2 The UXOQCS is responsible for on-site monitoring of the practices and operations taking place, and for verifying continued compliance with the specifications and requirements of the contract, approved project plans, and procedures. The UXOQCS will oversee and observe activities as specified in the initial inspection and will verify that corrective actions for unsatisfactory or nonconforming conditions have been taken before granting approval to continue work. Final follow-up phase checks will be conducted and all deficiencies corrected before starting additional features of work. Final follow-up checks will be documented and summarized in the DQCR.

4.6 AUDIT PROCEDURES

4.6.1 Field performance will be evaluated to ensure that the quality standards and contract objectives are achieved. The evaluation of field performance will be accomplished through audits of the DQCRs and field logbooks. The UXOQCS will ensure that documentation is being accurately reported.

4.6.2 For intrusive investigation activities, the UXOQCS will audit completed dig sheets and HGL's UXO MEC database for accuracy. The Senior Geophysicist will review dig results for all DGM anomalies investigated for reasonableness relative to the mapped geophysical response.

4.6.3 Corrective actions will be implemented when non-conformances or deficiencies are identified. In addition, field audits will be conducted periodically by the QC Manager. Procedures for auditing activities will be identified prior to implementation of the audits. The audit process involves identifying, documenting, and reporting non-conformances or deficiencies, initiating corrective actions through appropriate channels, and conducting a compliance review.

4.7 QUALITY CONTROL DOCUMENTATION

4.7.1 Project documents including the WP, Safety and Health Plan, and Standard Operating Procedures (SOPs) will be maintained up-to-date and made available to all project members where the work is being performed. All documents will be available in both a hardcopy version and in electronic form.

4.7.2 Individual field logbooks will be assigned to the UXOQCS, UXOSO, and Senior Geophysicist, and they will be used to document details of field activities during QC and safety monitoring.

4.7.3 QC checks will be conducted as follows:

- **Daily Briefings**—The UXOSO and UXOQCS will ensure that daily safety and operational briefings are conducted with the project team.
- **Communications**—
    - Positive communications with site personnel will be maintained throughout the workday.

   - At a minimum, communication checks will be conducted each morning before starting work. Additional checks will be performed as necessary throughout the workday to monitor progress, safety, and/or QC.
   - Teams will not start operations until satisfactory checks have been achieved.

- **Training**—The UXOSO and UXOQCS will ensure that initial site-specific training is performed for all field personnel prior to startup of field activities, and that all safety control measures have been established. Training will be accomplished using only approved training materials. The UXOSO and UXOQCS will ensure that all certifications are filed on site for review.
- **Documentation**—The UXOSO and UXOQCS will ensure the following:
   - Completion of all required documentation,
   - Compliance with the project's WP, QCP, and APP/SSHP, and
   - Review and submission of all job status reports and documentation.
- **QC inspections** - For analog grids, the UXOQCS will re-survey 10 percent of each grid. A grid is failed if a MEC item is found or if a previously unidentified anomaly with the characteristics of a MEC item is identified. Grid failure will result in re-survey of the particular grid.

4.7.4 Additionally, the QC team will observe the requisite number of anomalies per 100-anomaly lot for intrusive investigations performed in both digital and analog survey grids to ensure resolution IAW the acceptance sampling criterion. Successful resolution requires that all checked anomaly locations exhibit the following:

- No geophysical signal, or
- A signal too low to be associated with UXO/DMM, or
- A remnant signal shown to be associated with surface materials, or
- A signal but one for which a complete rationale exists for its presence.

4.7.5 The UXOQCS and the Senior Geophysicist will jointly verify that seed items have been mapped and recovered. Lot size for anomaly resolution will be 100 anomalies (or any part thereof) including at least one seed item for digital surveys and with four (4) coverage and two detection seed items for analog surveys. Pass/fail criterion is detection of each QC seed. Lot failure will require that each remaining anomaly of the 100-anomaly lot be individually checked. Once a grid has passed the QC check, the USACE representative will be notified for QA inspection.

4.7.1 Telephone Conversation Record

4.7.1.1 HGL will document project-related telephone conversations with USAESCH and other project personnel that result in direction or decisions pertinent to the project.

4.7.2 Meeting Minutes

4.7.2.1 HGL will document all project meetings with USAESCH and other project-related personnel. These meeting minutes will be typed and distributed to all meeting participants.

4.7.3 Daily Field Activity Records

4.7.3.1 All field activities affecting QC will be performed in accordance with documented procedures identified in the WP or applicable guidance. During field activities, records of daily events will be kept. The information to be recorded could include:

- Date and weather conditions;
- Personnel and equipment onsite;
- Scope and results of onsite meetings (e.g., planning, Safety and Health, and QA/QC);
- Scope and results of field QA/QC activities;
- Scope and results of safety and health activities;
- Details regarding any accidents or incidents; and
- Details regarding any field changes to the SOW.

4.7.4 Daily Quality Control Reports

4.7.4.1 DQCRs will be prepared using the standard form included in Appendix F and the QASP. The information in the DQCRs could include:

- Weather,
- Contractor/subcontractor areas of responsibility,
- Test and/or control activities performed with results, and
- Material, supplies and/or equipment received.

4.7.4.2 HGL will be responsible for preparing and submitting the DQCR. Electronic copies will be emailed to the PM and to other parties upon request. At a minimum, one DQCR report will be prepared and submitted for every day of work. DQCRs and QC logs are official/public documents of record. Each DQCR will be assigned and tracked by a unique number comprised of the project identification, MEC, and the date expressed as dd/mm/yyyy.

4.7.5 Safety Log

4.7.5.1 Safety logs (tail gate briefing forms) shall be maintained in the project files for inclusion in the final report. HGL shall prepare a log including, as a minimum, the following information:

- Preparer (name and signature),
- Date,
- Weather conditions, discussion of any incidents, accidents, or significant site events that may impact safety, and stopping work due to safety issues, and
- Signatures of all project personnel and visitors acknowledging that they have participated in a safety briefing.

4.7.5.2 Documentation of Health and Safety and tailgate meetings will be contained in a standard form that is included in Appendix F.

4.8 QUALITY CONTROL INSPECTIONS

4.8.1 The following quality control inspections will be conducted during the completion of the RI field activities.

4.8.1 Magnetometers

4.8.1.1 Detection equipment, such as the EM61-MK2, GPS systems, and handheld metal detectors, including any magnetometers used on the site for personnel safety while excavating anomaly locations, will be field-tested daily using the appropriate equipment test strip of known targets to verify and monitor equipment functionality during the RI. If the equipment does not perform adequately, it will be marked with a red “maintenance” tag and taken out of service until it is repaired or calibrated. The instruments will be checked at least twice daily, and records of all equipment checks will be maintained.

4.8.2 Measuring and Test Equipment

4.8.2.1 In cases where calibration of equipment is not required (i.e., Schonstedt or Whites metal detectors), documentation will be maintained that the equipment is functioning IAW manufacturers’ requirements and checkout protocol. These daily function checks will be documented in the equipment calibration log (Appendix F).

4.8.3 Equipment Inspection

4.8.3.1 Project personnel will inspect equipment affecting quality (such as DGM magnetometers) on a daily basis for obvious defects. In addition, the UXOQCS or the Senior Geophysicist will perform random inspections of equipment to ensure that the equipment is in proper working order and working consistent with established requirements. These inspections will be documented on the DQCR.

4.8.4 Explosives Inspection

4.8.4.1 The UXOQCS will document explosives inspections as required by the Explosives Management Plan.

4.9 QUALITY MANAGEMENT

4.9.1 The following sections define procedures for the management of quality during the completion of the RI activities at Camp Butner.

4.9.1 Resolving Quality Problems

4.9.1.1 Quality control failures will be documented with a non-conformance and/or project variance report, HGL will employ root cause analysis to identify the underlying cause(s) and take effective corrective action to alleviate those causes. Root cause analysis is a methodical approach to solve quality problems in a multi-step process and includes the following steps:

1. Identify the problem,
2. Identify possible root causes,
3. Identify patterns and causal relationships in the failed process/product to determine the most likely root cause,
4. Identify potential solutions,
5. Select and implement a solution,
6. Evaluate the effect of the implemented solution, and
7. Standardize the implemented corrective actions.

4.9.1.2 Factors considered in the analysis will include, but not be limited to:

- Staff qualifications and training.
- Standard operating procedures.
- Limits, capabilities, and integrity of equipment.
- Adequacy of quality control measures in-place.

4.9.1.3 Cause-effect diagrams will be used to identify and evaluate possible causes in a systematic manner. The root cause will be determined by tracing the problem back to its source and identifying the point in the process at which the quality failure occurred and why it occurred.

4.9.2 DGM Quality

4.9.2.1 QC procedures will be implemented to ensure that data acquisition, data processing, and anomaly identification methods meet the program objectives. These procedures include daily verification of sensor operations along with a check of the sensor positioning system used in data acquisition. In addition to data acquisition QC, an ongoing documented review of data processing will be accomplished. If any significant discrepancies exist in the positioning or repeatability of the data, the problem will be identified and corrected. The geophysical data will also be evaluated to determine if the “blind” seed items were detected and the positioning accurate. Blind seed detection floor is defined as 75% of the mean repeat response over a field QC seed item along the IVS transect yielding the smallest amplitude anomaly. Any problems will be documented and resolved by the QC geophysicist IAW the QC program. In data processing, QC steps include the following:

- Reviewing field data sheets and log forms for completeness,
- Reviewing static instrument standardization files to verify response repeatability,

- Monitoring data for gaps or incomplete coverage - areas with data gaps not caused by documented physical obstacles will be resurveyed,
- Monitoring survey line separation (across traverse),
- Visually comparing dig list anomaly selections to the DGM anomalies generated by the known seeded items,
- Tracking data processing steps to ensure that all data are processed in the same manner, and
- Documenting additional processing (i.e., filtering) that may be useful in data analysis and identification of dig list items.

4.9.2.2 As part of the standard QC process on DGM data, all corrections, edits, filtering, or normalization of the data used to identify the location of potential MEC anomalies will be recorded and described in the data processing log. Any discrepancies in positional accuracy of the data noted during the field review, including steps taken to correct or resolve any QC issues, will be described in detail.

4.9.2.3 The Senior Geophysicist will conduct an independent evaluation of raw and processed geophysical data to ensure that it meets quality standards set forth in the PWS. If needed, a geophysicist independent from the processing procedures may perform QA/QC checks of the data and processing. The Senior Geophysicist can carefully evaluate the geophysical data for any potential problems such as latency correction, abnormal data spikes, or inconsistent background values. The primary software that will be used in data processing and analysis will be Geosoft's Oasis Montaj. All processing steps, including filtering, latency corrections, and others, will be recorded for all datasets.

4.9.2.4 Data quality checks will be performed at least twice daily, after equipment is powered ON and before it is powered OFF. Table 4.2 presents the DGM quality performance requirements, standard, test frequency, and consequences of QC failures.

4.9.3 AGM Quality

4.9.3.1 Data quality/function (dynamic response repeatability) tests will be performed for analog instrumentations at least twice daily, before field survey and prior to end-of-day shutdown.

4.9.3.2 Detection systems quality requirements include:

- Identification of all key seed items during instrument function test strip procedures, and documentation in the team leader log;
- 100% of coverage seeds recovered;
- 100% of detection seeds recovered;
- 90% confidence that <5% of anomalies are unresolved.

4.9.3.3 The required precision for positioning systems is ±0.3 meter static repeat over known point.

4.9.4.4 Upon completion of a grid by the intrusive investigation team, the UXOQCS shall perform a QC grid inspection encompassing, at a minimum, 10 percent of the grid surface area using a handheld EM metal detector (i.e., White XLT). The list of grids completed, checked by QC, and ready for QA inspection will be updated daily and forwarded or made available to the USACE. Table 4.3 presents the AGM quality performance requirements

4.10 CORRECTIVE ACTION PROGRAM

4.10.1 All items and/or processes not meeting established requirements shall be identified and documented. All personnel discovering a situation that is not consistent with established requirements are to immediately notify their supervisor. The CAR process allows the identification of nonconforming conditions and a vehicle to address the concern as well as prevent its recurrence. Through this process, lessons learned are also incorporated into the program.

4.10.2 Potential remedies may include:

- Supplemental training,
- Replacement or modification of equipment in use,
- Acquisition of supplemental equipment,
- Revision/modification of existing procedures,
- Implementation of new procedures, and
- Changes in QC procedures.

4.10.3 Work that occurred up to the point of the process or product failure will be accepted. Once corrective actions are in-place, rework (if required to meet project objectives) will be performed from the point of the system failure forward.

4.10.4 Upon confirming that an event or item is not in compliance with requirements, a CEHNC Form 948 or a corrective action request (CAR) may be initiated. Any project member can initiate a CAR, and it must be forwarded immediately to the Quality Control Manager, who will maintain a CAR log for tracking CAR status. The PM and Quality Control Manager will be responsible for identifying the individuals who will be assigned the responsibility of completing the CAR. A copy if the nonconformance report (NCR)/CAR form is shown in Appendix F.

4.11 LESSONS LEARNED AND CONTINUOUS IMPROVEMENT

4.11.1 The project is designed to identify nonconforming conditions. As required by this program, actions are taken to correct nonconformances and to prevent their recurrence. These conditions will be assessed to determine if they are systematic or unique occurrences. After informal review and discussion by the project team, those conditions that might aid other projects will be written up as lessons learned, describing the original condition and results, changes made, and the resultant improvements. Lessons learned will be discussed in the final project report.

4.11.2 All personnel are encouraged to continuously review their processes and suggest changes that improve the process, provide benefits, or improve project efficiency, safety, and quality. These suggestions can be either formally submitted (written memo to project leadership) or informally through verbal discussions at project meetings.

4.12 QUALITY CONTROL OF CONTRACT SUBMITTALS

4.12.1 All field data and documents will be reviewed/verified for technical completeness and accuracy by the appropriate HGL technical/project management prior to transmitting deliverables to USAESCH. Notes recorded from formal and informal meetings through the duration of the project will be cross-checked to ensure applicable comments were addressed. Data will be delivered to USACE IAW the schedule specified in Table 4.4, as outlined in the PWS.

4.13 EMPLOYEE PROCESS TRAINING PLAN

4.13.1 All personnel shall have the experience and training necessary for their assigned tasks. Personnel shall meet the training requirements identified in the accompanying WP. Prior to beginning fieldwork or new phases of work, the Quality Control Manager or his/her designee(s) will review work processes with project personnel to ensure that they are adequately trained/refreshed in phase work requirements, standards, and procedures. New project personnel and subcontractors must review the WP and receive site-specific training.

4.13.2 All visitors to the site will be required to sign in with the UXOSO and receive the health and safety briefing. All visitors, regardless of their qualifications, must be escorted by project personnel.

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TABLES

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Table 4.1
Three Phase QC Requirements

Phase and Objective	Activity	Activity and Quality Requirement	Quality Control Verification
Preparation Phase (Prepare Site and Personnel)	Mobilization and Site Preparation	Personnel will mobilize, assemble equipment, and prepare the site as described in the WP.	• Daily Site Health and Safety Meeting Report • Personnel Qualification Verification • Calibration Log • Preparation Phase Checklist • DQCR • Field Logbooks
Initiation Phase (Initiate Field Activities/ Site Work)	Instrument-Added Visual Surveys and Mag and Flag Operations	UXO technicians and survey technician will mag and flag all project areas and identify all anomalies.	• Daily Site Health and Safety Meeting Report • Daily Equipment Checklist/Equipment Inspection Form • Initiation Phase Checklist • QC Surveillance Form. • Health and Safety Compliance Inspection • Geophysical Dig Sheet and Target History • DQCR • Field Logbooks
Follow-Up Phase (Execute Approved Fieldwork)	DGM Operations	DGM teams will perform required QC instrumentation and navigation tests. Project geophysicist will ensure that the DQOs are met and will review post-dig data.	• Daily DGM QC Audit Form • Navigation Function Checks • Processing QC • Geophysical Dig Sheets and Target History • DQCR • Field Logbooks
Follow-Up Phase (Execute Approved Fieldwork)	Anomaly Avoidance, Removal and Disposal	The UXOQCS or SUXOS will to inspect a minimum of 10 percent of the area cleared by the UXO team to verify completeness of UXO removal.	• Daily Site Health and Safety Meeting Report • Daily Equipment Checklist/Equipment Inspection Form • QC Surveillance • QA Audit Checklist • NCR/CAR • Lessons Learned Form • Health and Safety Compliance Inspection • Geophysical Dig Sheet and Target History • Form 1348 • DQCR • Field Logbooks
Follow-Up (Demobilize from Site)	Demobilization	Personnel will demobilize according to the schedule.	• Daily Site Health and Safety Meeting Report • Health and Safety Compliance Inspection • Field Logbooks

Table 4.2
Digital Geophysical Quality Performance Metrics[1]

Requirement	Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure[2]
Static Repeatability (Instrument Functionality)[3]	All	Response (mean static spike minus mean static background) +-10% of GPO/original value on all channels	Minimum of once daily	Day's data fails unless seed item is mapped that day with repeatable anomaly characteristics (see GSV Blind Seeding)
IVS[4]	All	Static response for each IVS seed ≥ 75% of value predicted by GSV calculator and/or Depth Response Curves as agreed to by PDT.	Minimum of once daily	Day's data fails unless GSV seed item is mapped that day with repeatable anomaly characteristics (see GSV Blind Seeding)
Along-Line Measurement Spacing	All	98% <=25cm along line[5]	By dataset	Dataset submittal fails
Speed	All	95% within max project design speed or demonstrated speed	By dataset	Dataset submittal fails unless new max speed successfully demonstrated at GPO or IVS.
GSV Blind Seeding	All	All blind coverage seeds detected within expected instrument response ranges.[6] Positional accuracy of GSV seed within 35cm +1/2 line spacing.	One or more ISOs per day per team.[7]	Dataset submittal fails
Coverage(*)	Grids	>90% coverage at project design line spacing.[8]	By dataset or grid[9]	Submittal fails unless gaps filled, additional data collected, or government refund for missing acreage.
Target Selection	All	All dig list targets are selected according to project design.	By grid or dataset[9]	Dataset submittal fails
Anomaly Resolution(*)[10]	Verification checking by DGM re-mapping[11] or Verification checking with original instrument of anomaly footprint after excavation[12]	If MEC[13]: 70% confidence <10% unresolved anomalies[14] If no MEC: 90% confidence <5% unresolved anomalies Accept on zero.	Rate varies depending on lot size.[15] See Acceptance Sampling Table.	Lot submittal fails

Table 4.2 (continued)
Digital Geophysical Quality Performance Metrics

Requirement	Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure[2]
Geodetic Equipment Functionality(*)	All	Position offset of known/temporary control point within 10 cm for PPK or RTK GPS survey instruments; ± 5 meters for WAAS-capable GPS equipment.[16]	Daily	Redo affected work or re-process affected data
Geodetic Internal Consistency	Grids with line/fiducial positioning	Grid corners are internally consistent within 30cm on any leg or diagonal.	Per Grid	Redo affected work (corner placement & data collection, or data processing)
Geodetic Accuracy	Points used for RTK or robotic total station (RTS) base stations	Project network must be tied to HARN, CORS, OPUS or other recognized network.[17] Project control points that are used more than once must be repeatable to within 5cm	For points used more than once, repeat occupation[18] of each point used, either monthly (for frequently used points) or before re-use (if used infrequently[19]).	Re-set points not located at original locations or resurvey point following approved WP.
Geodetic Repeatability(*)	Grid centroids or corners/transect points without anomaly reacquisition	Measured locations are reoccupied within 10m[20]	1 per lot	Lot submittal fails

[1]These are the critical requirements for RI DGM methods. Contractors shall use additional methods/frequencies that they deem beneficial and as required in their SOPs.
[2]All failures also require a root cause analysis.
[3]Item should be placed on a jig that ensures consistent geometry between the sensor and item to ensure repeatability, response not to exceed 500 units, or optionally use the Geonics calibration coil. Duration of data collection needed to be determined (TBD) by the contractor. Must compare to original to ensure instrument is consistent throughout the project. .It is recognized that this QC requirement may be redundant and could contradict results from seeding QC, however, in the event of seed failure, information from this test may aid in determining cause of failure, i.e., instrument or processing.
[4]IVS consists of at least one ISO but may also include other test items. IVS tests will be conducted at the start of fieldwork and a report will be submitted documenting error sources, background noise and expected response range for each item within the IVS.
[5]25cm based on institutional knowledge and common instrument physical dimensions. Assumes speed used achieves detection. This requirement can be relaxed if supporting documentation is provided to the Government for concurrence.
[6]Responses should fall within ranges predicted during initial IVS testing and/or within depth response curves as agreed to by PDT.
[7]Coverage seeds/GSV blind seeds are a combination of ISO standard test items (small, medium, large) and other test items or stimulants as required by the PDT.
[8]Recommended default line spacing is 0.6m for items of interest the size of 40mm grenades and smaller, else 0.8m.
[9]The terms "grid" and "dataset" refer here to logical groupings of data or data collection event. Logical groupings of data are contiguous areas mapped by the same instrument and in the same relative time-frame. These can be grids, acres, or some other unit of area. A data collection event is similar to logical groupings of data but refers to data collected over a contiguous time frame, such as "morning," "afternoon," "battery life," or some other measure of contiguous time. It is recognized that physical marking of corners on the ground is not always beneficial to the government. Additionally, size and shape of the grid is not specified.

Table 4.2 (continued)
Digital Geophysical Quality Performance Metrics

[10]Resolved is defined as 1) there is no geophysical signal remaining at the flagged/selected location, or 2) a signal remains but it is too low or too small to be associated with UXO/DMM, or 3) a signal remains but is associated with surface material which when moved results in low, or no signal at the interpreted location, or 4) a signal remains and a complete rationale for its presence exists.
[11]Mapping shall cover the required number of anomaly locations. This is used in lieu of checking individual anomalies for those instances where it is quicker to re-map sections of land rather than return to individual anomalies. Only the data at the anomaly locations is reviewed for resolution.
[12]This may require leaving flags at excavated locations until QC is complete. It is up to the contractor to indicate which holes knowingly have metal left in them where the PDT has agreed such is acceptable. It is the contractor's responsibility to not put hot material back in the hole before QC is complete. As part of this requirement location accuracy must also be demonstrated (i.e. cleared location is within dynamic positioning error radius as described above). Contractor SOPs that incorporate post-excavation inspections using digital geophysical instruments can be used to meet the excavation verification need of this requirement provided appropriate QC protocols are in place to monitor and document the SOPs are followed. Acceptance sampling or alternative QC protocols to monitor and document the reacquisition SOP would be required to demonstrate the correct locations are excavated.
[13]If MEC (or intact or partial training or practice rounds) are not detected in a lot then the information from that lot may be used to support certain decisions where the confidence in the results must be greater than that for grids where MEC are detected.
[14]This is a statistical test number. It does not imply there are 10% bad units. It tests there are fewer than 10% bad units, including zero bad units. Values for confidence levels will be determined by the PDT and are dependent on the information needed. Stopping rules will take precedence over this standard (i.e. for high MEC density, decision could be made to stop because the team has enough data for characterization)
[15]For example, if lot size is 500 anomalies, to achieve a 90% confidence that there are less than 5% unresolved anomalies, 43 anomalies must be re-checked. If any one of the 43 is unresolved, then the confidence level has not been met, the lot submittal fails and all anomalies in that lot must be re-checked (i.e. accept on zero). The contractor shall propose the lot size for government concurrence (i.e., the contractor determines the amount of risk they are willing to take. The larger the lot, the less sampling needs to be done, but the larger the risk of increased costs/rework if failure occurs.) For anomaly resolution, in order to use statistics/confidence levels, it is based on number of anomalies, not grids.
[16]Most high-accuracy systems should demonstrate repeatability between 5cm and 10cm. Typical accuracies achievable for some high-accuracy systems are: 2cm to sub-centimeter for RTK DGPS and RTS units depending on manufacturer and site conditions. Less accurate systems should demonstrate repeatability within manufacturer published ranges. Typical accuracies for less accurate systems are 5m to sub-meter for WAAS or satellite correction service DGPS units depending on manufacturer, correction service and site conditions, and 30m to 1m for USCG beacon corrected units depending on manufacturer.
[17]The plan for tying the project network to a common reference network must be described in the approved WP. If monumentation is part of the plan, specific monumentation procedures and DQOs will also need to be specified and installation of monumentation or network control points shall follow all guidance and accuracies specified in EC 1110-1-73 – "Standards and Specifications for Surveys, Maps, Engineering Drawings, and Related Spatial Data Products."
[18]Repeat occupation means demonstrate the control points being used can be recovered and reoccupied and that they have not moved more than the requirement specification. This can be accomplished using the same methodology used to initially tie the local network to a HARN, CORS, OPUS, or other recognized network, or it can be accomplished by other means that achieve this requirement.
[19]An example of frequently used control points would be points used as RTK digital GPS base stations. Infrequently used points could be those used during RTS operations where the control point was used during mapping and then again at some later time for reacquisition and QC statistical sampling. Infrequently used points could also include grid corners they are used for line and fiducial positioning and then subsequently re-used for reacquisition or QC statistical sampling.
[20]The exact location of a single transect/grid is not critical when the information is used only for characterization by interpolating over large areas (e.g., transect spacings are larger than geodetic accuracies). The acceptable accuracy may be tightened by the PDT if more exact positioning is needed (e.g., trying to characterize extents of small MRSs). If specific anomalies/locations must be recovered this metric must be revised to meet project needs and will likely have the same accuracy needs as the Geodetic Accuracy requirement.

Table 4.3
Analog Geophysical Quality Performance Metrics[1]

Requirement	Limited Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure[2]
Repeatability (Instrument Functionality)	All	All items in test strip detected (trains ear daily to items of interest)[3]	Min 1 daily[4]	Remedial training and additional remedial measures as described in the approved WP if due to operator error, or replacement of faulty equipment[5]
Dynamic Repeatability	Transects used only for density estimates	Repeat a segment of transect and show number of counts repeated w/in the greater of ∀20% or ∀8, or w/in range of adjacent segments.	2nd party repeat of 2% per lot	Redo lot
	Transects with digging	Repeat a segment of transect and show extra flags/digs not greater than the greater of 20% or 8 flags/digs, or w/in range of adjacent segments.	2nd party repeat of 2% per lot	Redo lot
Coverage(*)	Grids	Blind coverage seeds and blind detection seeds recovered[6]: 75% if MEC 90% if no MEC[7]	Variable rate at 2, 3 or 4 times # operators, per lot.	Redo lot.
Detection and Recovery (*)	Grids with No DGM QC remapping	Blind detection seeds recovered: 80% if MEC 100% if no MEC	Per operator per lot: variable 1-2 large/deep and 1-3 small/ shallow[8]	Redo lot
	Grids With DGM QC remapping	If MEC[9]: 70% confidence <10% unresolved anomalies[10] If no MEC: 90% confidence <5% unresolved anomalies Accept on zero.[11]	Rate varies depending on lot size. [Table showing acreage rates per lot size for varying confidence levels will be provided][12]	Redo lot

Table 4.3 (continued)
Analog Geophysical Quality Performance Metrics[1]

Requirement	Limited Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure[2]
Anomaly Resolution(*)[13]	Verification checking of excavated locations (analog or digital instrument)	2nd party checks open holes to determine: If MEC: 70% confidence <10% anomalies unresolved[14] If no MEC: 90% confidence <5% anomalies unresolved	Rate varies depending on lot size. See Acceptance Sampling Table.[15]	Redo lot
	Verification checking by DGM remapping[16]	Same as Detection and Recovery	Rate varies depending on lot size. See Acceptance Sampling Table.	Redo lot
Geodetic Equipment Functionality(*)	All	Position offset of known/temporary control point within expected range as described in the approved WP.[17]	Daily	Redo affected work
Geodetic Accuracy	Points used for RTK or RTS base stations	Project network must be tied to HARN, CORS, OPUS or other recognized network.[18]. Project control points that are used more than once must be repeatable to within 5cm	For points used more than once, repeat occupation[19] of each point used, either monthly (for frequently used points) or before re-use (if used infrequently[20]).	Re-set points not located at original locations or resurvey point following approved WP.
Geodetic Repeatability(*)	Grid corners/transect points without anomaly reacquisition	Measured locations are reoccupied within 10m.[21]	1 per lot	Redo affected work

[1]These are the critical requirements for RI analog methods. Contractors shall use additional methods/frequencies that they deem beneficial and as required in their SOPs.
[2]All failures also require a Root Cause Analysis.
[3]The requirement is that each operator demonstrates positive detection on a daily basis of the smallest and largest expected MEC of interest when it is placed at both its best and worst orientations and buried between 95% and 100% of their respective maximum consistent detection depth. Maximum consistent detection depth is defined as producing any above background response on a minimum of the first three time gates of the EM61MK2 optimized for site conditions and having a 0.9m^2 size or more as calculated using the Geosoft Oasis Montaj UCEAnalyseTarget.gx or equivalent routine.
[4]Random blind reconfiguration of test strip is also required (i.e., moving/adding items) at a frequency determined by the contractor and approved in the work plan, to address the potential for simply memorizing seed locations.
[5]Some examples of additional remedial measures are: removal of operator from mapping for one day, retesting on new blind strip meeting the same requirements for seed items (could move location of items in same area), 100% QC re-inspection of initial lanes by that operator, etc.
[6]Coverage seeds are small pieces of metal that will produce relatively large amplitude anomalies over small areas, such as small nails or ball bearings. Known location accuracy of placement is not critical. See endnote #8 for description of blind detection seeds.

Table 4.3 (continued)
Analog Geophysical Quality Performance Metrics[1]

[7]If MEC (or intact or partial training or practice rounds) are not detected in a grid/lot then the information from that grid/lot may be used to support certain decisions where the confidence in the results must be greater than that for grids where MEC are detected.
[8]Detection and recovery must be consistently demonstrated for the hard to detect items; therefore, the largest expected MEC and the smallest expected MEC shall be placed between 95% and 100% of their respective maximum consistent detection depth
[9]If MEC (or intact or partial training or practice rounds) are not detected in a lot then the information from that lot may be used to support certain decisions where the confidence in the results must be greater than that for grids where MEC are detected.
[10]This is a statistical test number. It does not imply there are 10% bad units. It tests there are fewer than 10% bad units, including zero bad units. Values for confidence levels will be determined by the PDT and are dependent on the information needed. Stopping rules will take precedence over this standard (i.e. for high MEC density, decision could be made to stop because the team has enough data for characterization)
[11]Unresolved anomaly for 'Detection & Recovery Testing' means a significant signal remains without a complete rationale for its presence. Default values for such a 'significant signal' are peak amplitude on sum channel >=30mv & anomaly width >=1.2m or anomaly size >=0.9m^2. This value may change but must be agreed upon by the PDT up front.
[12]The statistical calculations for this test are in progress. This is different from sampling of excavated holes, in that a portion of the acreage is re-mapped, and the amount re-mapped must be statistically valid to show, to some confidence level, that anomalies did not go undetected.
[13]This requires leaving flags at excavated locations until QC is complete. If shovel called to a flag during QC then the failure has already occurred—it is not important that something large or small comes out of the hole. Assumption here is "mapping coverage" is addressed through other means. It is up to the contractor to indicate which holes knowingly have metal left in them where the PDT has agreed such is acceptable. It is the contractor's responsibility to not put hot material back in the hole before QC is complete.
[14]Resolved is defined as 1) there is no geophysical signal remaining at the flagged/selected location, or 2) a signal remains but it is too low or too small to be associated with UXO/DMM, or 3) a signal remains but is associated with surface material which when moved results in low, or no signal at the interpreted location, or 4) a signal remains and a complete rationale for its presence exists.
[15]For example, if lot size is 500, to achieve a 90% confidence that there are less than 5% unresolved anomalies, 43 anomalies must be re-checked. If any one of the 43 is unresolved, then the confidence level has not been met, the lot submittal fails and all anomalies in that lot must be re-checked (i.e. accept on zero). The contractor shall propose the lot size for government concurrence (i.e., The contractor determines the amount of risk they are willing to take. The larger the lot, the less sampling needs to be done, but the larger the risk of increased costs/rework if failure occurs.) For anomaly resolution, in order to use statistics/confidence levels, it is based on number of anomalies, not grids.
[16]Mapping shall cover the required number of anomaly locations. This is used in-lieu of checking individual anomalies for those instances where it is quicker to re-map sections of land rather than return to individual anomalies. Only the data at the anomaly locations is reviewed for resolution.
[17]Most high-accuracy systems should demonstrate repeatability between 5cm and 10cm. Typical accuracies achievable for some high-accuracy systems are: 2cm to sub-centimeter for RTK DGPS and RTS units depending on manufacturer and site conditions. Less accurate systems should demonstrate repeatability within manufacturer published ranges. Typical accuracies for less accurate systems are 5m to sub-meter for WAAS or satellite correction service DGPS units depending on manufacturer, correction service and site conditions, and 30m to 1m for USCG beacon corrected units depending on manufacturer.
[18]The plan for tying the project network to a common reference network must be described in the approved work plan. If monumentation is part of the plan, specific monumentation procedures and data quality objectives will also need to be specified and installation of monumentation or network control points shall follow all guidance and accuracies specified in EC 1110-1-73 – "Standards and Specifications for Surveys, Maps, Engineering Drawings, and Related Spatial Data Products."
[19]Repeat occupation means demonstrate the control points being used can be recovered and reoccupied and that they have not moved more than the requirement specification. This can be accomplished using the same methodology used to initially tie the local network to a HARN, CORS, OPUS, or other recognized network, or it can be accomplished by other means that achieve this requirement.
[20]An example of frequently used control points would be points used as RTK DGPS base stations. Infrequently used points could be those used during RTS operations where the control point was used during mapping and then again at some later time for reacquisition and QC statistical sampling. Infrequently used points could also include grid corners they are used for line and fiducial positioning and then subsequently re-used for reacquisition or QC statistical sampling.
[21]The exact location of a single transect/grid is not critical when the information is used only for characterization by interpolating over large areas (e.g. transect spacings are larger than geodetic accuracies). The acceptable accuracy may be tightened by the PDT if more exact positioning is needed (e.g. trying to characterize extents of small MRS's). If specific locations must be recovered this metric must be revised to meet project needs and will likely have the same accuracy needs as the Geodetic Accuracy requirement, which is 30cm.

Table 4.4
Geophysical Submittals and Due Dates

	With Each Submittal	24 Hours After Collection	24 Hours After Request by Government Representative	By the Following Friday	7 Days After Completed Excavations of Each Grid	CD/DVD with Final Report
ReadMe File	X					
Index Map	X					
Updated DID_Tables Access Database	X					
First Week's Mapping and QC Data		X				
Special Request Draft Data			X			
Analog and DGM Data Package for Each Week's Data Collection (raw and final mapping and QC data, maps, field data sheets, and updated associated database tables)				X		
Intrusive Results Tables					X	
All Raw and Final Digital Data, Maps, Final Access Database, Final QC Documentation						X

5.0 EXPLOSIVES MANAGEMENT PLAN

5.0.1 This plan, consistent with DID WERS-002.01, outlines the procedures that will be used to perform MEC identification and disposal operations at the project site. HGL will acquire all required federal and state permits. Copies of explosives licenses or permits will be posted and available for inspection on each project site location where explosives materials are used. The procedures are IAW the following:

- FAR 45.5,
- ATFP 5400.7,
- DoDM 6055.09-M,
- AR 190-11,
- DOT Regulations, and
- HGL SOP 15.00, Explosives Accountability and Management (Appendix I).

5.1 LICENSES/PERMITS

5.1.1 HGL holds an ATF Type 20 Manufacturer of Explosives license to purchase and use explosives (Figure 5.1) on HGL project sites. The original license is posted at the HGL Munitions Response Team office headquartered in Albuquerque, New Mexico. A copy of this license will be posted at each HGL project site where explosive materials are stored and used, and will be available for federal state, or local inspections. Accountability and use of the explosives will remain with HGL unless custody is transferred to the U.S. Government or other agency with a current ATF explosive license. The state of North Carolina does not require state explosive license or permits to conduct explosive demolition operations for the disposition of MEC.

5.2 ACQUISITION

5.2.1 Acquisition Source and Method of Delivery

5.2.1.1 Demolition explosives will be shipped and delivered to the project site by Dyno Nobel, a commercial explosives dealer. The explosive dealer will be responsible for all permits and documentation required by federal, state, and local regulations for shipment and transportation of explosives. Demolition explosives will be store on site in accordance with the DDESB-approved ESP. Prior to delivery of the demolition explosives, HGL will confirm shipment data including the type, class, and net explosive weight (NEW).

5.2.1.2 Transportation of demolition explosives will be conducted IAW DOT regulations. HGL will maintain accountability/records for demolition explosives. If the explosives delivered cannot be stored/used on the same day on which they are delivered due to unforeseen circumstances (for example, electrical storms), HGL will return the explosives to the explosives dealer. The SUXOS will be authorized to request and receive explosives from the commercial explosive dealer.

5.2.2 Listing of Proposed Explosives

5.2.2.1 Hazard Classification/Division 1.4 explosives will be used whenever possible because they are safer to handle, easier and less expensive to ship and store, and more readily available. The demolition explosive materials anticipated for use on this project are shown in Table 5.1.

5.3 INITIAL RECEIPT OF EXPLOSIVES

5.3.1 Only those HGL employees listed on the Explosives Authorization List may sign for receipt of explosives from an explosives dealer. Upon the day of receipt of explosive materials at a project site the SUXOS will check the lot number or manufacturer's marks and nomenclature/description of each type of explosive item against the explosives dealer delivery manifest and record this information on the HGL Manufacturer of Explosives Record of Acquisition and the Magazine Data Card–Daily Summary of Magazine Transactions forms (Appendix F).

5.3.1 Receipt of Explosives

5.3.1.1 The original acquisition receipt documents and explosives usage inventory will be maintained on file by the SUXOS. The Magazine Data Card—Daily Summary of Magazine Transactions will be kept current and updated upon each explosive materials acquisition receipt/delivery, issue, return and inventory At the completion of the project, all original explosive materials records will be sent to HGL's Albuquerque office, where they will be maintained for a period of 5 years. Copies of these records will be included in the final report.

5.3.2 Reconciling Discrepancies

5.3.2.1 The SUXOS will first inventory explosives received by verifying the explosive material's lot number/manufacturer's marks, nomenclature/description, and quantity. The SUXOS will reconcile the delivery shipping documentation with the requested amounts ordered and received. Any shortages or overages will be reported to the project PM, who will contact the explosive materials distributor and reconcile any differences. HGL will then notify the explosives dealer, and when required the ATF, to reconcile any discrepancies.

5.4 EXPLOSIVES STORAGE MAGAZINE

5.4.1 Establishment of Storage Facilities

5.4.1.1 Explosives storage facilities will be established in accordance with the DDESB-approved ESP, HGL SOP 15.0, Explosives Management and Accountability (Appendix I), and HGL SOP 15.02, Explosive Storage and Security Inspections (Appendix I). Strict physical security and safeguarding of explosive materials will be strictly maintained at all times when explosive materials are stored, being delivered, or used. HGL will store the demolition explosive material on site in two Type 2 ATF-approved explosive storage magazines. HGL will comply with ATF, other federal, and local storage and compatibility criteria and procedures when siting explosives storage magazines, which include the following:

- Use portable, approved ATF Type 2 explosive storage magazines,
- Maintain the magazine(s) to comply with the explosive safety quantity distance requirements IAW ATFP 5400.7 and DoD 6055.9-M, and
- Install sufficient magazines or a type of magazine with an attached, separate detonator magazine to comply with explosive compatibility requirements (e.g., bulk explosives, initiating explosives).

5.4.2 Physical Security of Storage Facilities

5.4.2.1 A chain-link fence will be installed, which will be IAW DoD 5100.76-M and EM 1110-1-4009. Explosive storage magazine facilities will be inspected every seven days to coincide with the weekly inventory by the SUXOS and the UXOQCS/UXOSO to ensure the integrity of the enclosure. The SUXOS and UXOQCS will enforce access control and security of all explosives materials used on site.

5.5 TRANSPORTATION

5.5.1 Transportation of explosive materials will comply with federal (DOT 49 Code of Federal Regulations (CFR), Parts 171-173, and DoD), State, and local regulations. The transporter of the demolition explosives will transport explosives on-site using the least populated and safest route. Blasting caps and HEs will be transported in an ATF-approved Type 3 day-box mounted in the bed of a pickup truck.

5.5.1 Vehicle Safety Requirements

5.5.1.1 When transportation of explosives by vehicles is required the following procedures will be implemented.

5.5.1.1 Transport Checklist

5.5.1.1.1 Explosives will be transported in closed vehicles whenever possible. The load will be braced and covered with a fire-resistant tarpaulin or in an appropriate shipping container. Minimum requirements for vehicles transporting explosives or UXO/MEC are listed below:

- The vehicles will be inspected using the Motor Vehicle Inspection-Hazardous Material Checklist, HGL MR Form 15.06 and properly placarded per DOT 49 Code of Federal Regulations (CFR) requirements.
- The vehicles will be equipped with a first aid kit, two 10-BC fire extinguishers, and a means of communication with the UXOSO.
- Vehicles engines will be off when loading or unloading explosives.
- Wheels will be chocked during loading and unloading to prevent movement.
- At no time will any bare explosive come into contact with spark-producing metal. Vehicle cargo beds will have wooden or plastic liners, dunnage, or sand bags to protect the explosives from contacting the metal bed and fittings.

- Explosives may be transported in vehicles with plastic bed liners if the explosives are in an authorized original shipping container.

5.5.1.2 General Precautions

5.5.1.2.1 When transportation of explosives requires travel on public highways, the SUXOS and UXOSO will coordinate jointly to provide the UXO team with a safe transportation route plan. Every effort will be made to take a route with the least public exposure. For transportation of demolition material, HGL will comply with the following:

- Initiating explosives, such as blasting caps, will remain separated from other explosives at all times. Blasting caps may be transported in the same vehicle as long as they are in a separate container conforming to Institute of Makers of Explosives requirements and secured away from other explosive items.
- An Institute of Makers of Explosives 122 box will be used to transport blasting caps, and the HEs will be placed in an ATF Type 3 day-box. The two containers will be placed in the bed of a vehicle, and blocked and braced separately using sand bags or other suitable means to keep the containers from shifting. If the load in being transported in an open vehicle, the load will be covered with a tarp.
- Compatibility requirements will always be observed.
- Only UXO-qualified personnel who have been “cleared” by the ATF will have access and authority to issue explosive materials. The receiving party shall sign the receipt documents for accountability.
- Vehicle operators transporting explosives will be a UXO-qualified HGL employee, ATF “cleared,” and possess a valid driver’s license and a commercial Class-C driver’s license with a HAZMAT endorsement when transporting HAZMAT on public roads.
- Vehicle operators will comply with posted speed limits but will not exceed a safe and reasonable speed for road/field conditions. Vehicles transporting explosives off-road will not exceed a speed of 25 miles per hour.
- Personnel will not ride in the cargo compartment of a vehicle transporting explosives.

5.6 RECEIPT PROCEDURES

5.6.1 The SUXOS will strictly control access to all explosives. All issues, turn-ins, and inventories of explosives will be properly documented and verified, though physical count, by the SUXOS and UXOQCS.

5.6.1 Records Management and Accountability

5.6.1.1 Upon receipt, the type, quantity, and lot number of each explosive item will be checked against the manifest and recorded on the Magazine Data Card-Daily Summary of Magazine Transactions. A copy of the original receipt documents and an inventory will be maintained on site by the site supervisor. The Magazine Data Card-Daily Summary of Magazine Transactions will remain in the magazine with the explosive items and be annotated and updated upon each issue, receipt, and inventory.

5.6.1.2 ATF requires HGL to maintain explosive records for commercial purchases for a period of 5 years. Original copies of all explosive material purchases, receipts, issuances, inventories, and usage transaction records will be maintained on site by the SUXOS IAW 27 CFR § 555.13, and will be available for inspection by authorized agencies. Explosive items will be tracked by their respective manufacturer's marks of identification or lot number until the items are expended or transferred to government control, or are returned to the original ATF-licensed explosives dealer. Upon completion of project field operations, all original explosives records will be sent to HGL's office in Albuquerque, New Mexico, for archiving throughout the life of HGL's explosives license. Copies of all records will be maintained on site by the SUXOS and be available for inspection by authorized agencies. Explosive items will be tracked using the lot number until the item is expended or transferred to government control and accountability.

5.6.2 Authorized Individuals

5.6.2.1 Only HGL employees who have undergone a successful ATF background check IAW 18 U.S.C. § 843(h), and 27 CFR § 555.33 and § 555.45(c), will be authorized to purchase explosive materials and have direct physical contact with them for the purposes of storage, transportation, and use. Every HGL employee required to handle, transport, or store explosives must clearly understand their responsibilities for properly safeguarding and securing explosive materials.

5.6.2.2 HGL is required to provide commercial explosive dealers with documentation of individuals authorized to request and sign for receipt of explosive materials. Only those listed on the HGL Legal Transaction of Explosives Signature List will be authorized to purchase and accept receipt of explosive materials. For this project the primary authorized individual to receive and issue explosives is the SUXOS, and the alternate authorized individual will be the UXOQCS.

5.6.3 Certification

5.6.3.1 The SUXOS and UXO Technician III team leader performing demolition operations will sign and date the Explosives Usage Record (Appendix F) certifying that the explosives were used for their intended purpose.

5.6.4 Procedures for Reconciling Receipt Documents

5.6.4.1 The SUXOS will reconcile the delivery shipping documentation with the requested amounts ordered and received. Any shortages or overages will be reported to the HGL PM, who will contact the explosives supplier to reconcile any differences.

5.7 INVENTORY

5.7.1 When explosives are first received on site and once every 7 days thereafter the SUXOS and the UXOQCS will perform a true and accurate physical inventory of all explosive materials stored on site. All inventories will be properly. The SUXOS will strictly control access to all explosives and will review all requests for explosives for the site.

5.8 MAGAZINE INSPECTION

5.8.1 The SUXOS and the UXOQCS will be responsible for the inspections and security of the explosives storage magazines. The SUXOS and UXOQCS will perform all inspections with another UXO-qualified individual, who should not be the same person on subsequent inspections.

5.8.1 Project Startup Inspection

5.8.1.1 Prior to establishing an explosives storage magazine and receiving explosive materials, a security survey inspection will be conducted by the SUXOS and UXOQCS using the Explosive Storage and Security Survey Checklist. The result of this survey will be documented using the Explosive Storage Magazine Inspection Checklist and in the daily report prepared by the SUXOS.

5.8.2 Weekly Inspections

5.8.2.1 Weekly physical inspections will commence upon initial acquisition of explosive materials. The Explosive Storage Magazine Inspection Checklist will be used for conducting and documenting weekly explosive storage inspections. Upon completion of this inspection, the checklist will be signed by the individual conducting the inspection. The SUXOS will also sign the inspection checklist upon completion of their review of this form. This inspection checklist will be maintained with the site's project files. This inspection includes, but is not limited to, the following:

- Explosive storage magazine(s) grounding systems,
- Placards and signage,
- Fire hazards,
- Posting of fire/chemical hazards and safety information,
- Explosive compatibility,
- NEW limits,
- Explosive material container labeling and packing,
- Housekeeping,
- Explosive storage magazine integrity,
- Fencing security,
- Evidence of forced entry, sabotage, tampering or vandalism,
- Vegetation,
- Magazine lock and key accountability,
- Abnormal odors and temperatures, and
- Emergency point of contact information displayed.

5.8.3 Grounding Inspection

5.8.3.1 A local qualified electrician will be contracted to ensure that the grounding of the lightening protection system meets the criteria of the National Electrical Code (NEC) and National Fire Protection Association 780 as directed by DoD Manual 6055.09-M, DoD Ammunition and Explosives Safety Standards, Volume 2, Enclosure 4.

5.9 REPORTING LOST OR STOLEN EXPLOSIVES MATERIALS

5.9.1 If it is confirmed that MEC or explosive materials are missing, the SUXOS will immediately notify the HGL PM and each agency identified below in the following order:

1. Local law enforcement authorities,
2. Local ATF office,
3. HGL Senior UXO Operations or UXO Safety Managers,
4. USACE CO (immediately by telephone and in writing within 24 hours of the discovery), and
5. ATF U.S. Bomb Data Center (BDC) (within 24 hours of discovery using ATF E-Form 5400.5, Report of Loss or Theft—Explosive Material and the emergency contact information in Table 5.2).

5.9.2 After all required notifications have been made, the completed Report of Theft or Loss–Explosive Material (ATF E-From 5400.5) will be faxed to the U.S. BDC, (toll free) 1-866-927-4570.

~ WARNING ~

FAILURE TO REPORT THE THEFT OR LOSS OF ANY EXPLOSIVE MATERIALS MISSING FROM STOCK WITHIN 24 HOURS OF DISCOVERY TO THE APPROPRIATE FEDERAL AND LOCAL AUTHORITIES IS A FELONY OFFENSE.

5.10 PROCEDURES FOR RETURN TO STORAGE OF EXPLOSIVES NOT EXPENDED

5.10.1 The UXOSO or UXOQCS, will return unexpended explosives to storage at the end of explosives operations and record the transaction as a return on the appropriate magazine data cards.

5.10.2 Each explosive item will be counted. All containers will be opened and counted, and any discrepancies will be noted. The original receipt document will be adjusted to reflect the returned material and will be signed by the individual returning the explosives and a second authorized HGL UXO technician.

5.11 PROCEDURES FOR DISPOSAL OF REMAINING EXPLOSIVES

5.11.1 ATF requires accurate accounting of all explosive materials purchased and used; therefore, when work is completed or temporarily suspended at a project site, all unused explosives will be either disposed of by detonation or returned to the ATF-licensed dealer from which the explosives were purchased.

5.12 FORMS

5.12.1 HGL will use internal forms for explosives receipt, issue, and inventory, and for vehicle inspections. Explosives accountability forms are located in Appendix F.

TABLES

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Table 5.1
List of Proposed Explosives

Nomenclature	Description	Quantity	Hazard/ Classification Division	Compatibility Group	NEW (lbs)
Perforators	32 grams	100	1.4	S	7.1
Detonating Cord	80 grain/feet	1,000 feet	1.1	D	11.4
Detonators, Nonel®	40’ Lead	60	1.4	B	9.8
Booster, PETN	¾ Pound	49	1.1	D	46.7
Total NEW					75.0

Table 5.2
Emergency Contact Information

Personnel	Telephone Number	Hours
HGL SUXOS, Scott Schroepfer	(707) 330-6411	All hours
HGL PM, Derek Anderson	(706) 372-5138	All hours
Local Law Enforcement	911	All hours
ATF BDC	(800) 461-8841	Mon-Fri, 8:00 a.m.–5:00 p.m.
	(888) 283-2662	After hours
	(866) 927-4570	Fax
Senior UXO Operations Manager, John Melcher	(505) 341-2010	Mon-Fri, 7:30 a.m.–4:30 p.m.
	(360) 631-6056	After hours
UXO Safety Manager, Ron Mendenhall	(505) 280-2036	After hours
USAESCH PM, Chris Cochrane	(256) 895-1696	Mon-Fri, 8:00 a.m.–5:00 p.m.

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6.0 ENVIRONMENTAL PROTECTION PLAN

6.0.1 This Environmental Protection Plan (EPP) describes the approach, methods, and operational procedures that will be employed to protect the natural environment during performance of all RI field tasks. The EPP has been developed to document site-specific environmental conditions in and adjacent to the MRSs at the former Camp Butner. The EPP addresses the potential impacts that the proposed actions may have on the surrounding environment and suggests measures to be implemented during the proposed actions to protect identified environmentally sensitive areas.

6.1 PLAN OBJECTIVES

6.1.1 The plan also identifies environmental management controls that will prevent and/or decrease the environmental impact in and around the project location. The objectives of this plan are to

- Define methods and procedures to minimize the polluting of air, water, and land resources;
- Protect identified, environmentally sensitive cultural and/or historical resources; and
- Execute RI field activities in the project work area IAW all applicable federal, state, and local regulations.

6.2 POLLUTION MINIMIZATION METHODS

6.2.1 Based on the nature of the site work to be conducted, HGL anticipates little, if any, environmental impact to land, air, or water. No stormwater impacts are anticipated. Hand-dug excavations will be on a very limited scale, not requiring runoff controls. Other than during the possible disposal of a UXO item by detonation, noise is not anticipated to be a concern. If HGL personnel recognize an increase in pollution potential, the work will be stopped temporarily, and the HGL and the USACE PMs will evaluate and, if necessary, take the appropriate steps to mitigate the situation. If necessary, this WP will be modified.

6.3 IDENTIFICATION AND LOCATION OF KNOWN NATURAL RESOURCES

6.3.1 HGL was not scoped to complete an environmental survey prior to conducting operations at the project site. A discussion of the existing environmental conditions and natural resources believed to be present at the former Camp Butner location is presented in the following sections.

6.3.1 Federally or State Threatened or Endangered Plant and Animal Species

6.3.1.1 Current information regarding endangered, threatened, and protected species was compiled for Granville and Person Counties using the U.S. Fish and Wildlife Service Endangered Species Act (ESA) List (updated February 1,2012) and the North Carolina Natural Heritage Program (NCNHP), Divisions of Parks and Recreation, Department of Environmental and Natural Resources List (updated September 2010). The information provided included six vertebrate animal species (one bird and five fish) and seven invertebrate animal species that potentially occur in the local area.

6.3.1.2 The following species of vertebrates occur within Granville and Person Counties with the status of Federal Species of Concern (FSC) under the ESA or as a species of special concern (SC) or significantly rare (SR) under the NCNHP Plant Protection and Conservation Act (PPCA):

- Roanoke bass (*Ambloplites cavifrons*) - FSC
- Pinewoods shiner (*Lythrurus matutinus*) - FSC
- Carolina darter (*Etheostoma collis lepidinion*) - FSC
- Carolina madtom (*Noturus furiosus)* - FSC
- American eel (*Anguilla rostrata*) - FSC

6.3.1.3 The only vertebrate species that has federal status as threatened under the ESA and threatened status under the NCNHP PPCA in the project area is the Bald Eagle (*Haliaeetus leucocephalus*).

6.3.1.4 The following species of invertebrates occur within Granville and Person Counties with the status of FSC under the ESA or as a species of SC or SR under the NCNHP PPCA:

- Atlantic pigtoe (*Fusconaia masoni*) - FSC
- Brook floater (*Alasmidonta varicose*) - FSC
- Chowanoke crayfish (*Orconectes virginiensis*) - FSC
- Green floater (*Lasmigona subviridis*) - FSC
- Yellow lampmussel (*Lampsilis cariosa*) - FSC
- Yellow lance (*Elliptio lanceolata*) - FSC

6.3.1.5 The only invertebrate species that has federal status as endangered under the ESA and endangered status under the NCNHP PPCA in the project area is the Dwarf Wedgemussel (*Alasmidonta heterodon*) occurring in Granville and Person Counties.

6.3.1.6 The following plant species occur within Granville and Person Counties with the status of FSC under the ESA or as a species of SC or SR under the NCNHP PPCA:

- Butner's Barbara's-buttons (*Marshallia* sp.) – FSC
- Prairie birdsfoot-trefoil (*Lotus unifoliolatus var. helleri*) – FSC
- Smooth-seeded hairy nutrush (*Scleria* sp. 1) – FSC
- Tall larkspur (*Delphinium exaltatum*) – FSC
- Torrey's Mountain-mint (*Pycnanthemum torrei*) – FSC
- Sweet pinesap (*Monotropsis odorata*) - FSC
- Virginia quillwort (*Isoetes virginica*) – FSC

6.3.1.7 The only plant species that have federal status as endangered under the ESA and endangered status under the NCNHP PPCA in the project area are Harperella (*Ptilimnium nodosum*), and Smooth Coneflower (*Echinacea laevigata*).

6.3.2 Wetlands

6.3.2.1 Wetlands are transitional areas between terrestrial and deep-water habitats in which the water table is usually at or near the surface or the land is covered by shallow water. Wetlands provide habitat for waterfowl, fish, other terrestrial and aquatic animals, and a wide variety of plant life. Wetlands also provide resting and feeding places on migration routes, as well as food, shelter, breeding areas, and nurseries for many species.

6.3.2.2 No known jurisdictional wetlands are known to exist at the former Camp Butner. However, if potential wetlands are identified in the field based on field indicators (i.e., vegetation, signs of wetland hydrology), the HGL team will make every attempt to avoid disturbing wetlands within the project area.

6.3.3 Cultural and Archaeological Resources

6.3.3.1 Should any artifacts or remains be encountered during field activities, no HGL personnel or subcontractor will remove or disturb them and their presence shall be reported to USAESCH PM. Avoidance of impact to archeological or cultural resources is a primary concern, and HGL will take every precaution to protect these important resources.

6.3.3.2 ARNG has a process whereby they engage the local tribes regarding potential impacts to cultural issues. It is anticipated that these Native American Tribes will be consulted to acquire their input on tribal affiliation to, or any interests in, lands and/or cultural resources in the project area and its vicinity. It is not expected that there will be any issues or concerns with the proposed engagement with the tribes. The ARNG does not foresee any issues but will look into engaging the tribes anyway to brief them on the project.

6.3.4 Water Resources

6.3.4.1 Two lakes are located on the south end of Camp Butner, Lake Butner (also known as Holt reservoir, the source of potable water for the City of Butner) and adjacent Lightning Lake. Additionally, the site contains several streams and tributaries that are part of the Falls Lake watershed. Stormwater impacts are not anticipated because excavations will be hand-dug, and on a very limited scale, and will not require runoff controls.

6.3.5 Tree and Shrub Removal

6.3.5.1 Limited vegetation removal will be necessary at the MRSs to aid in survey and clearance activities. The vegetation to be removed may include immature trees (less than 4 inches in diameter), low-lying tree branches, brush, and field grasses. All items will be cut to a level that allows clearance activities to be conducted, but allows re-growth of the vegetation with time. Trees that are 4 inches in diameter or greater, measured at chest height, will not be cut unless specifically authorized by the USAESCH. Similarly, brush less than 3 inches in diameter will only be cut in direct coordination with the USAESCH.

6.3.6 Existing Waste Disposal Sites

6.3.6.1 There are no existing waste disposal sites within the project area.

6.4 ARAR COMPLIANCE

6.4.1 CERCLA response actions are exempted by law from the requirement to obtain federal, state or local permits related to any activities conducted completely on site. It is the policy of the EPA (and the DA) to ensure that all activities conducted on site are protective of human health and the environment, however, this does not eliminate the requirement to meet (or waive) the substantive provisions of permitting regulations that are ARARs. Table 6.1 lists the primary laws and regulations that may apply to actions planned for this project. This table is considered to be a living document subject to modification if additional ARARs are encountered and discussed. The evaluation of the ARARs is an iterative process to be performed throughout the life of the project.

6.5 PROTECTION OF NATURAL RESOURCES

6.5.1 Field activities outlined in this WP will be conducted in a manner to minimize impacts to the natural resources listed in Section 6.3. For the geophysical activities, transects and grids will be placed in a manner that avoids any sensitive areas. This goal will be achieved by prior knowledge of any sensitive biological or archaeological resources at the MRSs and placement of the preliminary transects and grids to avoid these areas. In general, the small size of the transects and grids relative to the whole study area will also help ensure that impacts will affect a very small overall study area. In addition, the amount of brush cutting in transects and grids will be kept to the minimum amount necessary to conduct the geophysical surveys.

6.6 SITE-SPECIFIC MITIGATION MEASURES

6.6.1 Trees and Shrubs

6.6.1.1 Because of the limited vegetation removal activities planned in the MRSs, no tree or shrub restoration is planned after clearance activities are completed.

6.6.2 Waste Disposal

6.6.2.1 All waste generated will be properly characterized, and disposed of IAW all applicable regulations and through approved channels. It is expected that only uncontaminated trash will be generated as a result of this project.

6.6.2.1 <u>Nonhazardous Wastes</u>

6.6.2.1.1 Environmental sampling may generate several waste streams requiring disposal. IDW may include PPE, solid waste, and decontamination water. In addition, scrap metal may be generated as a result of the investigation of metallic geophysical anomalies. Based on the nature of the site and existing data, it is expected that only nonhazardous IDW will be generated during the field sampling event. Nonhazardous IDW such as decontamination fluids from the washing and rinsing of sampling equipment will be collected and properly disposed of. It is expected that solid IDW (e.g., rubber gloves and other plastics) will be collected separately in trash bags and disposed of as municipal solid waste.

6.6.2.2 Hazardous Wastes

6.6.2.2.1 HGL does not anticipate generating contaminated or hazardous wastes during the execution of the project; however, if hazardous wastes are generated they will be disposed of IAW with the procedures described in the following sections.

6.6.2.3 Packaging, Labeling, Storage, and Disposal

6.6.2.3.1 All hazardous materials will be stored in authorized containers and labeled IAW applicable regulations. Any waste generated by HGL will be collected, stored, and labeled IAW applicable regulations.

6.6.2.4 Manifesting and Transporting Wastes

6.6.2.4.1 HGL does not anticipate that there will be any hazardous wastes that will need to be manifested or transported. However, in the unlikely event that hazardous materials and wastes are generated, they will be manifested and transported IAW applicable DOT and EPA regulations.

6.6.2.5 Compliance with DOT Shipping Regulations

6.6.2.5.1 Transportation of all wastes and materials will be conducted IAW applicable DOT regulations, including use of labels, use of placards, and documentation of transportation.

6.6.3 Security of Hazardous Materials

6.6.3.1 HGL personnel will provide security to control the work area. All hazardous materials associated with the project (primarily explosives) will be secured as discussed in Section 5.0 of this WP.

6.6.4 Burning Activities

6.6.4.1 No burning activities are planned for this project. However, at the ARNG site controlled burning is performed annually by the ARNG and is conducted over a segment or portion of the property every year. HGL will attempt to schedule the RI activities to coincide with the controlled burning events to minimize the amount of vegetation clearances required for the RI.

6.6.5 Dust and Emission Control

6.6.5.1 EPA has established National Ambient Air Quality Standards pursuant to Sections 109 and 301(a) of the Clean Air Act. These standards, expressed in micrograms per cubic meter, establish safe concentration levels for each criteria pollutant. Standards have been set for six pollutants: particulate matter, sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. The proposed project would result in a minimal amount of air pollution in the form of smoke and fugitive dust emissions. Smoke and fugitive dust emissions may result from support vehicles including trucks; however, impact from these operations should not be significant and should not have any long term environmental impact on air quality.

6.6.5.2 If necessary, areas requiring dust control will be watered down. Prevailing wind directions will be determined prior to the start of daily fieldwork, and will be considered in planning fieldwork.

6.6.6 Noise Control and Prevention

6.6.6.1 It is expected that mechanical equipment (that is, trucks) will be the one primary source of noise on this project. HGL will control the noise emissions from this equipment by ensuring that the mufflers on the trucks are functioning. Given the distance to any populated structures, it is unlikely that the equipment will create a nuisance noise effect. The OSHA Permissible Exposure Limit for noise is 85 decibels (29 CFR 1910.95). It is considered highly unlikely that this noise level would be reached.

6.6.7 Spill Control and Prevention

6.6.7.1 <u>Spill Potential</u>

6.6.7.1.1 Due to the nature of the operations, the potential for a spill of pollutants during operations is low. The highest probability for a spill will occur during refueling operations of equipment such as gas and oil tanks on chainsaws. In the event of a spill during one of these refueling operations, the largest quantity of pollutant that could be lost is likely less than 1 gallon of gasoline or oil. HGL plans to conduct all fueling and repair of vehicles off site. This practice will reduce the need to store large amounts of liquids on site. HGL anticipates that unleaded gasoline, diesel fuel, and motor oil will be the only liquids with hazardous constituents that may be stored on site in quantities greater than 5 gallons. If it becomes necessary to store the liquids with hazardous constituents in a storage tank, the tank will be placed within an approved secondary containment of adequate size to contain a spill (that is, 110 percent of storage container size).

6.6.7.2 <u>Spill Control Measures</u>

6.6.7.2.1 All containers of liquid containing petroleum products or other chemicals with potentially hazardous chemical constituents will be carefully managed and kept closed. The containers will be stored away from the main operations to decrease the chances of container damage an chances of spoilage.

6.6.7.2.2 Vehicles will be maintained in good operating condition and left running only when necessary. As indicated earlier all vehicles will be fueled, maintained, and serviced at an off-site location. No routine cleaning or washing of vehicles or equipment will be permitted on site.

6.6.7.2.3 Safety cans or other approved portable service containers of flammable liquids having a flash point at or below 73EF will be painted red with a yellow band around the can and the name of the contents conspicuously painted or stenciled on the container in yellow. Drums, barrels, and flammable-liquid containers will be tightly capped.

6.6.7.2.4 When refueling heavy equipment and/or small power tools the following measures will be taken to minimize the potential for and impact from any spills:

- Spill pans will be placed on the ground under the fill cap to catch any spills.
- The operator will not leave the fueling operation and will continually monitor the activity and be present throughout the time it takes to complete the operation.
- When the equipment is full the fuel flow will be suspended and the nozzle will be carefully removed from the equipment to ensure that there are no drips from the nozzle.

6.6.7.3 Spill Response

6.6.7.3.1 Any spills originating from small containers (e.g., gasoline cans) will be contained by use of absorbent materials. HGL will arrange for spill kits to be present on site for the immediate cleanup of any petroleum products that may be inadvertently spilled. Should fuel or oil be spilled onto the ground the following measures will be taken:

- The spill area will be isolated and contained.
- The appropriate emergency response agencies will be immediately notified. A spill of over 1 gallon is required to be reported to the USAESCH on-site representative. If human health or the environment is threatened, the National Response Center and the state will be notified as soon as possible.
- The liquid and affected soils will be removed and first placed into plastic bags; after that the bags will be placed into U.S. Department of Transportation (DOT)-approved containers for disposal at a permitted facility.
- Each of the DOT-approved containers will be labeled to identify the contents.

6.6.8 Storage Areas and Temporary Facilities

6.6.8.1 HGL anticipates establishing a temporary office trailer, storage facility, and portable toilets to support operations required during this project. Upon project completion, HGL will remove all temporary facilities, portable toilets, and associated debris from the site.

6.6.9 Access Routes

6.6.9.1 HGL will use the existing road network and county community roads outside the facility to gain access to the MRSs. No environmental impact is anticipated from the use of existing roads because they are currently in use by the general public.

6.6.10 Control of Water Run-on and Runoff

6.6.10.1 HGL will conduct work associated with this site investigation in a manner that prevents the discharge of pollutants into adjacent waterways within and outside of the project area. The use of berms, dikes, and barriers with plastic sheeting will be employed as needed to control water run-on/runoff and sediment migration/siltation. Sediment and erosion control measures will be maintained as long as their need exists.

6.6.11 Decontamination and Disposal of Equipment

6.6.11.1 Nondisposable PPE and equipment will be decontaminated prior to reuse as indicated in the WP. The disposition of disposable PPE and disposable equipment is addressed in the Quality Assurance Project Plan (Appendix E).

6.6.12 Minimizing Areas of Disturbance

6.6.12.1 All activities associated with this project will be conducted in a manner that will minimize impacts to land resources within and outside the project boundaries. Areas affected by the project will be restored, as practical, to their original condition. Ruts and excavation holes will be backfilled with the native materials removed. No additional fill material will be brought on site. The area of soil that will be disturbed is not anticipated to be above the threshold that requires an erosion and sediment control plan.

TABLES

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Table 6.1
Environmental Regulations Relevant to MEC Investigations

Regulatory Authority	Location Characteristic	Requirement	Synopsis	Action to be Taken to Attain Applicable Regulations to the Extent Practicable
Federal	Endangered Species	Endangered Species Act of 1973	Bald Eagle (federally listed threatened and state-listed imperiled species) Dwarf Wedgemussel - (federally listed endangered species) Harperella - (federally listed endangered species) Smooth Coneflower - (federally listed endangered species)	Informal consultation with Raleigh, North Carolina, Ecological Services Field Office to identify possible wildlife and plants within the area of investigation that are threatened with extinction.
Federal	Cultural Resources Archaeological Resources	National Historic Preservation Act of 1966 and the Archaeological Resources Protection Act of 1979	Requires federal agencies to take into account the effect that activities could have on cultural and historical properties. Requires a permit to excavate, remove, or otherwise alter any archaeological resource.	Informal consultation with the North Carolina Historic Preservation Officer concerning significant cultural resources within the project limits.

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7.0 PROPERTY MANAGEMENT PLAN

7.0.1 A Property Management Plan is required if HGL is provided U.S. Government-furnished equipment or U.S. Government-furnished property; however, issuance of such items is not anticipated for completion of this project.

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8.0 INTERIM HOLDING FACILITY SITING PLAN FOR RCWM PROJECTS

8.0.1 Not used at this time.

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9.0 PHYSICAL SECURITY PLAN FOR RCWM PROJECTS

9.0.1 CWM is not anticipated at the site. However, if during site operations HGL personnel encounter a suspected toxic chemical munition or CWM, they will immediately withdraw upwind, outside of the MSD of the ordnance, and notify the USACE Safety Specialist. HGL will secure the site with a UXO technician until the arrival of an emergency response team.

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