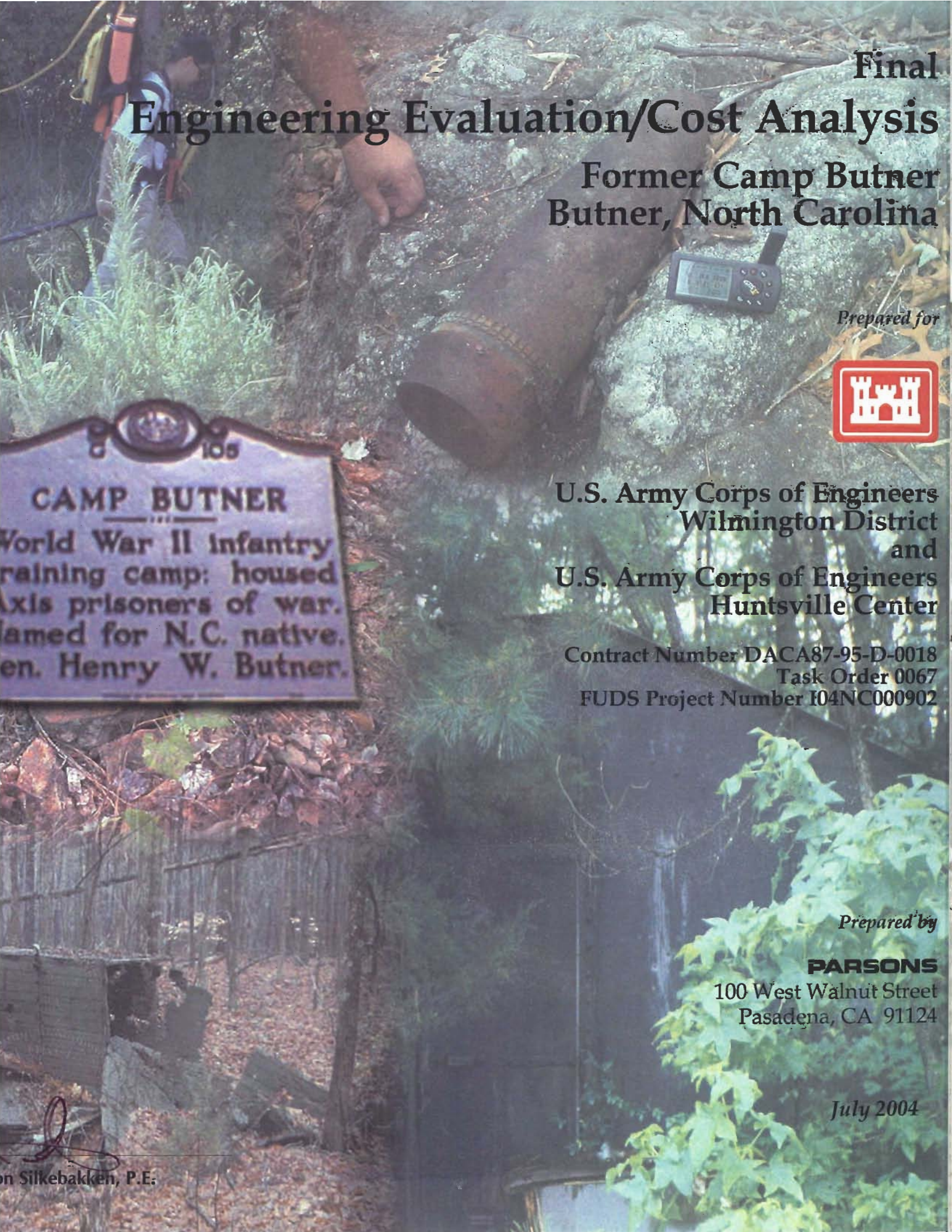

Final
Engineering Evaluation/Cost Analysis

Former Camp Butner
Butner, North Carolina

Prepared for

U.S. Army Corps of Engineers
Wilmington District
and
U.S. Army Corps of Engineers
Huntsville Center

Contract Number DACA87-95-D-0018
Task Order 0067
FUDS Project Number I04NC000902

Prepared by

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100 West Walnut Street
Pasadena, CA 91124

July 2004

on Silkebakken, P.E.

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LIST OF ACRONYMS

A/E	architect/engineer
AOI	area of interest
AP-T	armor piercing w/tracer (Table 3.1)
ARAR	applicable or relevant and appropriate requirement
ASR	Archives Search Report
bgs	Below Ground Surface
CESAW	Corps of Engineers, Wilmington District
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulation
DA	Department of the Army
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DID	Data Item Description
DoD	U.S. Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
EMS	Emergency Management System
EOD	Explosives and Ordnance Disposal
ESA	Endangered Species Act
FDE	Findings of Fact and Determination of Eligibility
FSC	Federal Species of Concern
FUDS	Formerly Used Defense Site
GIS	Geographic Information System
GPS	Global Positioning System
HE	High Explosive
HTW	Hazardous and Toxic Waste
IA	Institutional Analysis
IC	Institutional Controls
ID	Identification
INPR	Inventory Project Report
mm	millimeter
MMR	Military Munitions Response
MSD	Minimum Separation Distance
MPM	Most Probable Munition

LIST OF ACRONYMS (CONTINUED)

NCNG	North Carolina National Guard
NCNHP	North Carolina Natural Heritage Program
NCP	National Contingency Plan
NDAI	No DoD Action Indicated
NHPA	National Historic Preservation Act
NOES	Non Ordnance-Related Scrap
OE	Ordnance and Explosives
OE RIA	OE Risk Impact Assessment
OES	Ordnance and Explosives Scrap
Parsons	Parsons, Inc.
PM	Project Manager
POW	Prisoner-of-War
PPCA	Plant Protection and Conservation Act
PTT	Powder Time Train (Table 3.1)
QA	Quality Assurance
QC	Quality Control
RAB	Restoration Advisory Board
RAC	Risk Assessment Code
ROE	Right-of-Entry
RTK	Real-Time Kinematic
SARA	Superfund Amendments and Reauthorization Act
SC	Species of Special Concern
SOW	Statement of Work
SI	Site Investigation
SR	Significantly Rare
SUXOS	Senior UXO Supervisor
TBC	To Be Considered
TCRA	Time Critical Removal Action
TDMD	Time Domain Metal Detector
TEC	Topographic Engineering Center
TNT	Trinitrotoluene
TPP	Technical Project Planning
USA	USA Environmental, Inc.
USACE	U.S. Army Corps of Engineers

LIST OF ACRONYMS (CONTINUED)

USAESCH	U.S. Army Engineering and Support Center, Huntsville
UXO	Unexploded Ordnance
WP	Work Plan

EXECUTIVE SUMMARY

ES1 The former Camp Butner Site is a 40,384 acre site located approximately 15 miles north of Durham, partly in Durham, Granville, and Person Counties, North Carolina. The U.S. Army Engineering and Support Center, Huntsville (USAESCH) contracted Parsons to perform an Engineering Evaluation/Cost Analysis (EE/CA) at the project site. The purpose of the EE/CA is to characterize the type, location and distribution of unexploded ordnance (UXO), assess the risk posed by any residual UXO, evaluate risk management alternatives, and identify and recommend the appropriate response action alternatives to address the risk to the public.

ES2 The War Department acquired the former Camp Butner property from private land owners in 1942 to be used as a training and cantonment facility during World War II. The camp was primarily established for the training of infantry divisions (including 78th, 89th, and 4th) and miscellaneous artillery and engineering units. The ordnance used at the camp included rockets, mortars, grenades, and artillery rounds up to 240mm. UXO/ordnance and explosives (OE) that may be encountered within the camp include: 2.36-inch rockets (practice and high explosive [HE]), rifle and hand grenades, 20mm through 155mm HE projectiles, 60mm and 81mm mortars, anti-personnel practice mines, and demolition items to include TNT.

ES3 On January 31, 1947, the War Department declared Camp Butner excess. Dedudding operations were initiated in 1947 and subsequent inspections resumed in 1949. Six areas identified during dedudding inspections in 1949 and 1950 received land restrictions to 'surface use only' due to numerous HE duds found (Figure ES-1a). These areas do not all correspond to known historic training ranges. Most of the affected property was sold back to the original owners, with provisions outlined in the property deed restricting land use to 'surface use only'. The State of North Carolina negotiated the purchase of 10,000 acres to be used to support the existing hospital. On November 3, 1947, the State purchased the hospital, later named the John Umstead Hospital, and 1,600 acres of the cantonment area to be used for various projects and agricultural development. The North Carolina National Guard (NCNG) was conveyed 4,750 acres of the former Camp Butner for training purposes.

ES4 As part of the Archives Search Report (ASR), an OE risk assessment was conducted for the former Camp Butner as a whole using the procedure developed by the U.S. Army Corps of Engineers (USACE) in accordance with MIL-STD-882C and AR 385-10. The site was divided into 6 areas for evaluation purposes (Figure ES-1b). A Risk Assessment Code (RAC) score was calculated and the camp received a RAC score of 1. As a result, performance of an EE/CA was recommended on Areas 1, 2, 3, and 4. Area 5 was

defined as uncontaminated. Area 6, the active NCNG training site, was not eligible for characterization under this EE/CA.

ES5 Parsons performed digital geophysical mapping within Areas 1 through 5 for the purposes of identifying and locating the presence of UXO/OE items. Supplementary geophysical sampling was conducted using "mag and dig" methods. A total of 7087 anomalies were intrusively investigated within the 5 areas of interest (AOIs) covering approximately 108 acres of the site during this EE/CA. During intrusive sampling, a total of 13 UXO items were recovered: 2 UXO (including an Mk II hand grenade and M1 practice landmine with fuze) in Area 1; and 11 [including a nose fuze, three 37mm projectiles, three 2.36-inch rockets, one 57mm projectile, two 105mm projectiles, and one 155mm projectile] in Area 4. Although OE scrap was recovered, no UXO was identified in Areas 2, 3, or 5.

ES6 During the EE/CA investigation, findings made by a property owner at the Lakeview Subdivision resulted in the allocation of sampling grids at this location. Based on the intrusive results, which included the demoliton of a 37mm projectile, a Time Critical Removal Action (TCRA) was conducted at the Lakeview Subdivision. The 0 to 6-inch removal action was conducted over a 26-acre site. A total of six additional UXO items were recovered including an electric blasting cap, M1 A1 practice landmine fuze, Mk II hand grenade, 37mm projectile, and two 2.36-inch rocket warheads.

ES7 Based on results of the EE/CA intrusive investigation, the AOIs designated in the ASR were revised in order to delineate localized regions where UXO was recovered (see Figures ES-1b and ES-1c). The modified AOI boundaries coincided with former ranges identified in the ASR, as well as facilitated the selection of response alternatives. A total of 9 sectors were created from the re-sectorization of the original 5 AOI boundaries. The process of re-sectorization combined Areas 1 (excluding the water tower/flamethrower range), 2, 3, and 5 into a modified Area 5. In contrast, Area 4 was parceled into 7 AOIs which now include: Areas 4A, 4B, 4C, 4D, 4E, 4 (remaining land), and Lakeview Subdivision. Area 1A was formed to capture the unanticipated findings around the former Camp Butner water tower/flamethrower range.

ES8 A qualitative baseline risk evaluation was conducted using the OE Risk Impact Assessment (OE RIA) model to evaluate ordnance and explosive risk to the public from residual UXO items within these 9 AOIs. Results of the evaluation concluded that the explosive safety risk in Area 4A, Area 4B, Area 4C, and Lakeview Subdivision is high. Risk levels for Area 4D, 4E, and Area 4 (proper) ranged from low to moderate. The risk model indicated that the explosive safety risk for Area 1A is moderate to high. Area 5, comprising the largest AOI, was deemed low.

ES9 Four OE response action alternatives were identified and screened for each AOI within the former Camp Butner. An initial screening was performed using the general criteria of effectiveness, implementability, and cost. The response alternative remaining after the initial screenings included: No DoD Action Indicated (NDAI); Institutional Controls (ICs); Surface Clearance; and Clearance to Depth. Results from a

comprehensive analysis of the screened alternatives identified the most appropriate alternatives for each AOI (Figure ES-1d). Although the NDAI alternative was technically recommended for Area 5 based on strict application of the comparative analysis, the project team recommends site-wide IC. The Clearance to Depth alternative is recommended for Areas 1A, 4A, 4B, and 4C. In light of the recently completed TCRA at the Lakeview Subdivision and subsequent interpretation of potential remaining subsurface ordnance, Clearance to Depth is also recommended for this AOI. The Surface Clearance alternative was analyzed but was not recommended for any of the AOIs within the former Camp Butner.

ES10 For Area 4D, Area 4E, and Area 4 (remaining land) site-wide IC strategies are recommended despite the confirmed presence of UXO during the EE/CA. This recommendation was based on current and future anticipated land use, terrain, exposure pathways, and other factors outlined in Chapter 4 that indicate a removal action is not justified at this time. However, to ensure public safety associated with the residential component in each of these areas, a subsurface removal action is recommended (comprising a two-acre residential footprint) encompassing each existing residential dwelling. It should be noted that site-wide IC components will also be implemented, although not selected as necessary via comparative analysis evaluation, for the entire site. The overall estimated cost (in 2004 dollars) to implement the EE/CA recommendations (identified in paragraphs ES9 and ES10) is $9,618,666.

ES11 The project Administrative Record, which includes the ASR and other pertinent project documents, is maintained at two locations. The records are available for public access at the South Branch of the Granville County Library at 1547 S. Campus Drive, Creedmoor, North Carolina as well as the Town of Butner Operations Center, 205C West E Street, Butner, North Carolina.

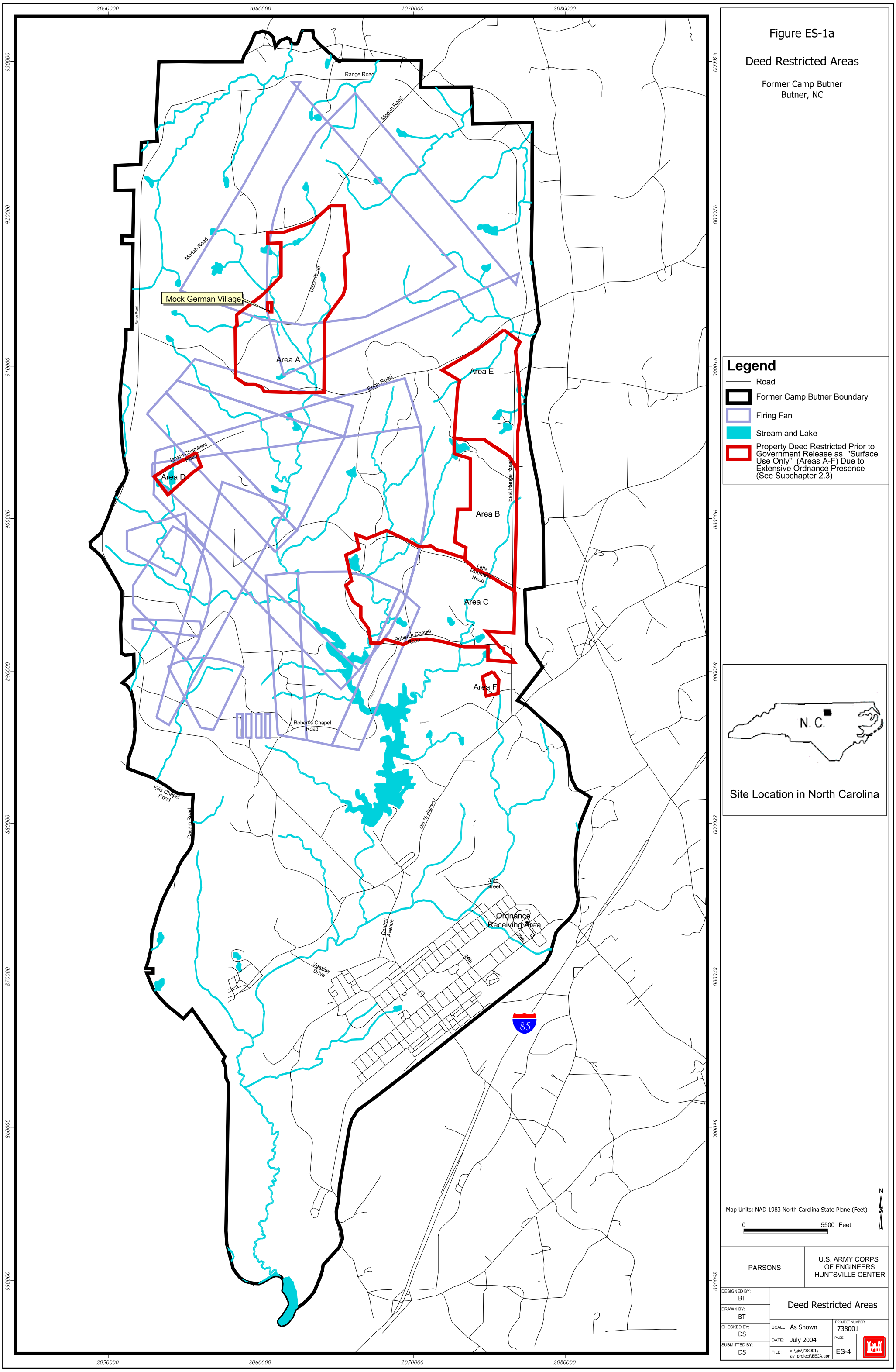
Figure ES-1a
Deed Restricted Areas
Former Camp Butner
Butner, NC
Legend
Road
Former Camp Butner Boundary
Firing Fan
Stream and Lake
Property Deed Restricted Prior to Government Release as "Surface Use Only" (Areas A-F) Due to Extensive Ordnance Presence (See Subchapter 2.3)
Site Location in North Carolina
N. C.
Map Units: NAD 1983 North Carolina State Plane (Feet)
0
5500 Feet
N
Range Road
Moriah Road
Uzzle Road
Mock German Village
Area A
Area E
Enon Road
Isham Chambers Road
Area D
East Range Road
Area B
Little Mountain Road
Area C
Robert's Chapel Road
Area F
Ellis Chapel Road
Casam Road
Old 75 Highway
33rd Street
Ordnance Receiving Area
Central Avenue
29th Ct.
24th
Veasley Drive
85
2050000
2060000
2070000
2080000
930000
920000
910000
900000
890000
880000
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850000
PARSONS
U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER
DESIGNED BY: BT
DRAWN BY: BT
CHECKED BY: DS
SUBMITTED BY: DS
Deed Restricted Areas
SCALE: As Shown
DATE: July 2004
FILE: x:\gis\738001\av_project\EECA.apr
PROJECT NUMBER: 738001
PAGE: ES-4

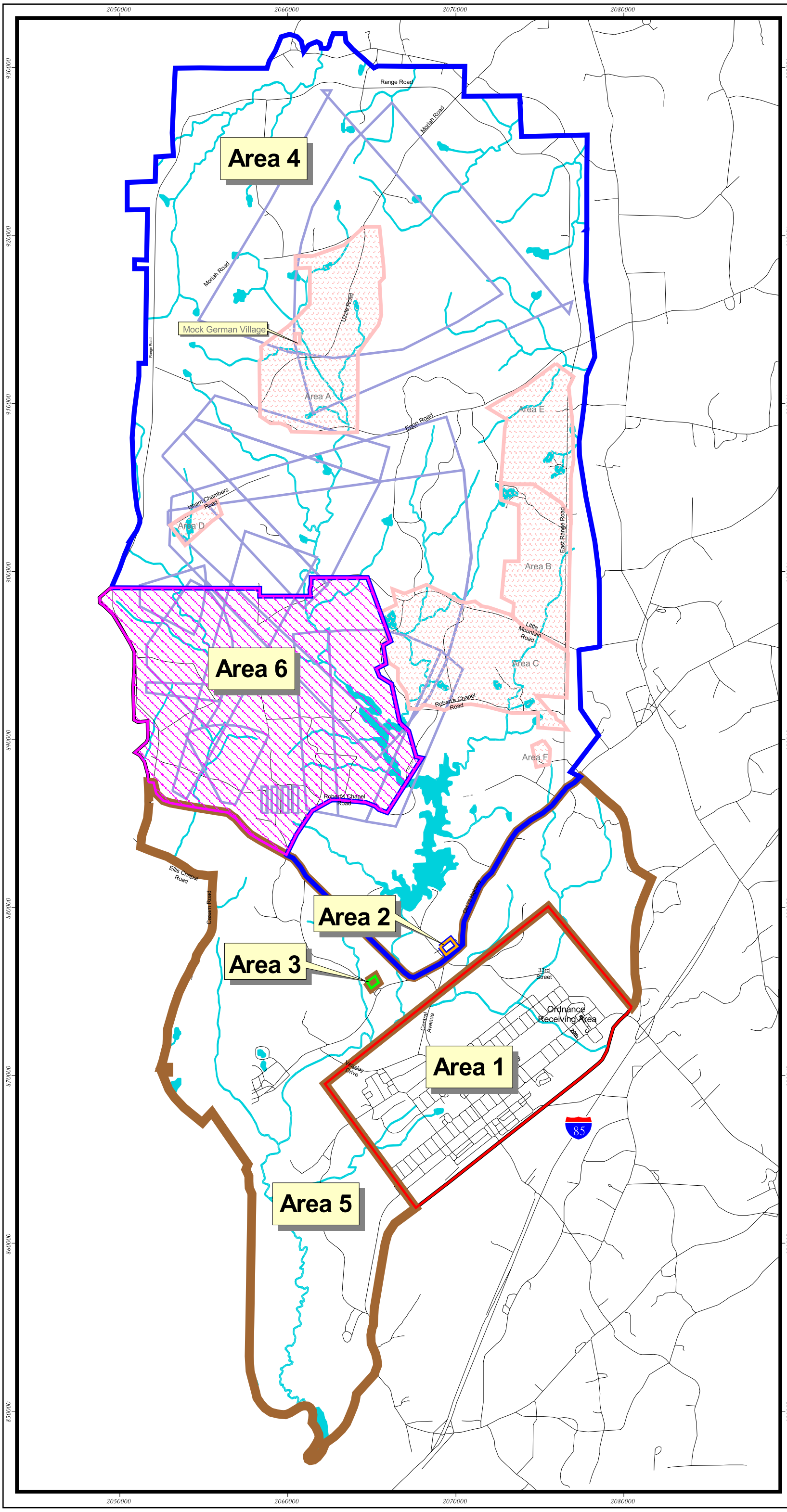


Figure ES-1b

ASR-Designated Project Areas

Former Camp Butner
Butner, NC

Legend

ASR-Designated Areas:

- Area 1 - Cantonment Area & Vicinity
- Area 2 - Ammunition Storage Area & Dump
- Area 3 - Grenade Training Ranges
- Area 4 - Ammunition Training Ranges & Impact Area
- Area 5 - Remaining Land
- Area 6 - National Guard Training Center
- Road
- Firing Fan
- Stream and Lake
- Property Deed Restricted Prior to Government Release as "Surface Use Only" (Areas A-F) Due to Extensive Ordnance Presence (See Subchapter 2.3)

Site Location in North Carolina

Map Units: NAD 1983 North Carolina State Plane (Feet)

0 5500 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	ASR-Designated Project Areas		
DRAWN BY: BT			
CHECKED BY: DS	SCALE: As Shown	PROJECT NUMBER: 738001	
SUBMITTED BY: DS	DATE: July 2004	PAGE: ES-5	
	FILE: x:\gis\738001\av_project\EECA.apr		

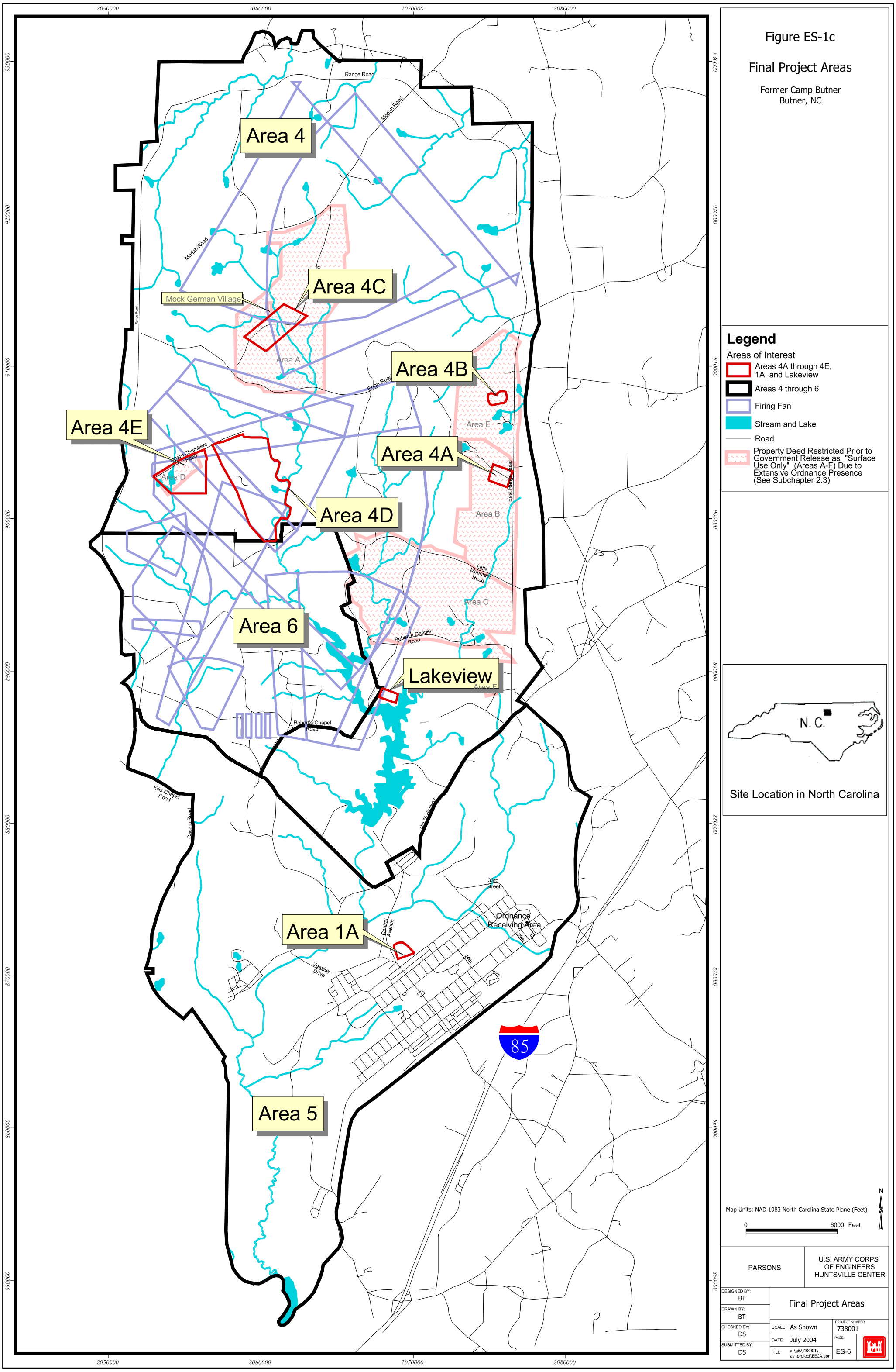
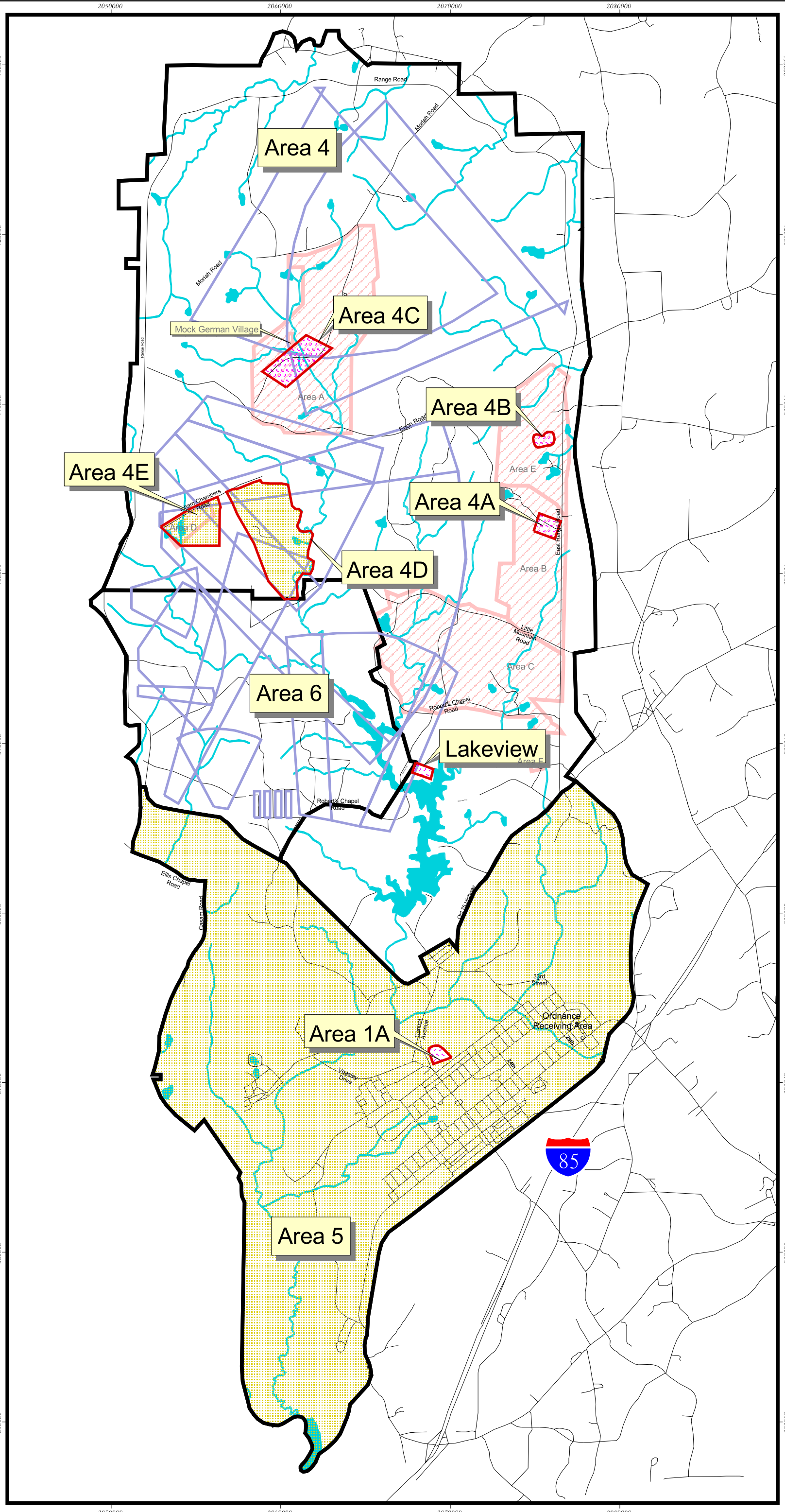


Figure ES-1c
Final Project Areas
Former Camp Butner
Butner, NC
Area 4
Area 4C
Area 4B
Area 4E
Area 4A
Area 4D
Area 6
Lakeview
Area 1A
Area 5
Mock German Village
Range Road
Moriah Road
Eaton Road
Nam Chambers Road
East Range Road
Little Mountain Road
Robert's Chapel Road
Ellis Chapel Road
Casam Road
Old Oxford Highway
33rd Street
Central Avenue
Ordnance Receiving Area
24th St
Veasley Drive
85
Area A
Area B
Area C
Area D
Area E
Area F
Legend
Areas of Interest
Areas 4A through 4E, 1A, and Lakeview
Areas 4 through 6
Firing Fan
Stream and Lake
Road
Property Deed Restricted Prior to Government Release as "Surface Use Only" (Areas A-F) Due to Extensive Ordnance Presence (See Subchapter 2.3)
N. C.
Site Location in North Carolina
Map Units: NAD 1983 North Carolina State Plane (Feet)
0
6000 Feet
N
PARSONS
U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER
DESIGNED BY: BT
DRAWN BY: BT
CHECKED BY: DS
SUBMITTED BY: DS
Final Project Areas
SCALE: As Shown
DATE: July 2004
FILE: x:\gis\738001\av_project\EECA.apr
PROJECT NUMBER: 738001
PAGE: ES-6

Figure ES-1d

OE Response Recommendations

Former Camp Butner
Butner, NC



Legend

Areas of Interest

- Areas 4A through 4E, 1A, and Lakeview
- Areas 4 through 6
- Firing Fan
- Stream and Lake
- Road

Recommendation:

- Site Wide IC (Areas 4D, 4E, and 5)
- Subsurface Clearances (Areas 1A, 4A, 4B,4C, and Lakeview)
- Property Deed Restricted Prior to Government Release as "Surface Use Only" (Areas A-F) Due to Extensive Ordnance Presence (See Subchapter 2.3)

Site Location in North Carolina

Map Units: NAD 1983 North Carolina State Plane (Feet)

0 6000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER
DESIGNED BY: BT	OE Response Recommendations
DRAWN BY: BT	
CHECKED BY: DS	SCALE: As Shown / PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004 / PAGE: ES-7
	FILE: x:\gis\738001\av_project\EECA.apr

CHAPTER 1
INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) report presents a characterization of the type, location and distribution of ordnance and explosives (OE) and unexploded ordnance (UXO) present within the boundaries of the former Camp Butner as identified for investigation in the project Work Plan (Parsons, 2002). In addition, an assessment of safety risk to the public from residual UXO/OE as well as an evaluation of feasible UXO/OE response actions was conducted.

1.1 BACKGROUND

1.1.1 Camp Butner consists of approximately 40,384 acres that includes the town of Butner and the North Carolina National Guard (NCNG) Camp Butner Training Site. Because the NCNG training site is an active range, the 4,750 acres comprising the range area were excluded from the EE/CA investigation.

1.1.2 The War Department acquired the former Camp Butner property from private land owners in 1942 to be used as a training and cantonment facility during World War II. The Camp was primarily established for the training of infantry divisions (including 78th, 89th, and 4th) and miscellaneous artillery and engineering units. At least 15 ammunition training ranges were established within the Camp. The ordnance used at the Camp included rockets, mortars, grenades, and artillery rounds up to 240mm, and various initiating and priming material used as obstacles and mine field clearing devices. UXO/OE that may be encountered within the Camp include: 2.36-inch rockets (practice and high explosive [HE]), rifle and hand grenades, 20mm through 240mm HE projectiles, 60mm and 81mm mortars, anti-personnel practice mines, and demolition items to include trinitrotoluene (TNT). A detailed description of the site and its historical use is presented in Chapter 2 of this report.

1.1.3 The U.S. Army Corps of Engineers (USACE), U.S. Army Defense and Ammunition Center and School, and the USACE Rock Island District (Rock Island Illinois), conducted a records search and reconnaissance of the project site in March 1993. The findings are documented in the Archives Search Report (ASR) and ASR Supplement (USACE, 1997/2003). A summary of the ASR is presented in Chapter 2 of this report.

1.2 PROJECT AUTHORIZATION

Parsons received Contract No. DACA87-95-D-0018, Task Order No. 0067, from the U.S. Army Engineering and Support Center, Huntsville (USAESCH) to conduct an

EE/CA of the former Camp (Appendix A). This EE/CA was performed in a manner consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Sections 104 and 121; Executive Order 12580; and the National Contingency Plan (NCP). All activities involving work in areas potentially containing UXO hazards were conducted in accordance with USAESCH, USACE, Department of the Army (DA) and Department of Defense (DoD) requirements regarding personnel, equipment, and procedures. The 29 Code of Federal Regulations (CFR) 1910.120 were applied to all actions taken at this site.

1.3 PURPOSE AND SCOPE

The purpose of this EE/CA at the former Camp Butner Site is to characterize OE nature, location, and concentration; provide a description of the OE-related hazards affecting human use of the site; identify and analyze reasonable risk management alternatives; and provide a convenient record of the process for use in final decision making and judicial review. The scope of work conducted to achieve the objectives of this EE/CA included a review of existing documents, site visit, collection of geophysical data to identify potential OE, subsurface investigation of selected anomalies, and preparation of this report as detailed in the Statement of Work (SOW [Appendix A]).

1.4 PROJECT TEAM

The technical project team consisted of USACE Wilmington District (CESAW), USAESCH, Parsons, and USA Environmental, Inc. (USA). The roles of these team members are described below and depicted in Figure 1.1. A detailed description of the project team members can be found in Chapter 3 of the approved project Work Plan (WP, [Parsons, 2002]).

1.4.1 U.S. Army Corps of Engineers, Wilmington District

CESAW is the Life Cycle Project Manager (PM) and funding agency for this project. CESAW's responsibilities include review of project plans and documents, obtaining Right-Of-Entry (ROE) to properties in the investigation areas, working with the news media and the public, and coordinating with State and local regulatory agencies on issues pertaining to protection of ecological and cultural resources. Mr. Robert Keistler is CESAW's PM for this project and Mr. John Baden is the Technical Lead.

1.4.2 U.S. Army Engineering and Support Center, Huntsville

USAESCH is the lead technical agency for this project. USAESCH responsibilities include procurement of architect/engineer (A/E) services, direction of the A/E contractor, review and coordination of project plans and documents, and working with the news media and the public. USAESCH provided technical expertise for OE activities during the field activities. As the technical project manager, USAESCH is also responsible for controlling the budget and schedule. Mr. Roland Belew is USAESCH's PM for this project.

1.4.3 Parsons

Parsons is the prime A/E contractor to USAESCH and provides overall engineering support and services for the EE/CA. Parsons was responsible for performance of the activities detailed in the SOW (Appendix A). Parsons' responsibility also included the control of project schedule and budget. Mr. Don Silkebakken is Parson's PM for this project.

1.4.4 USA Environmental, Inc.

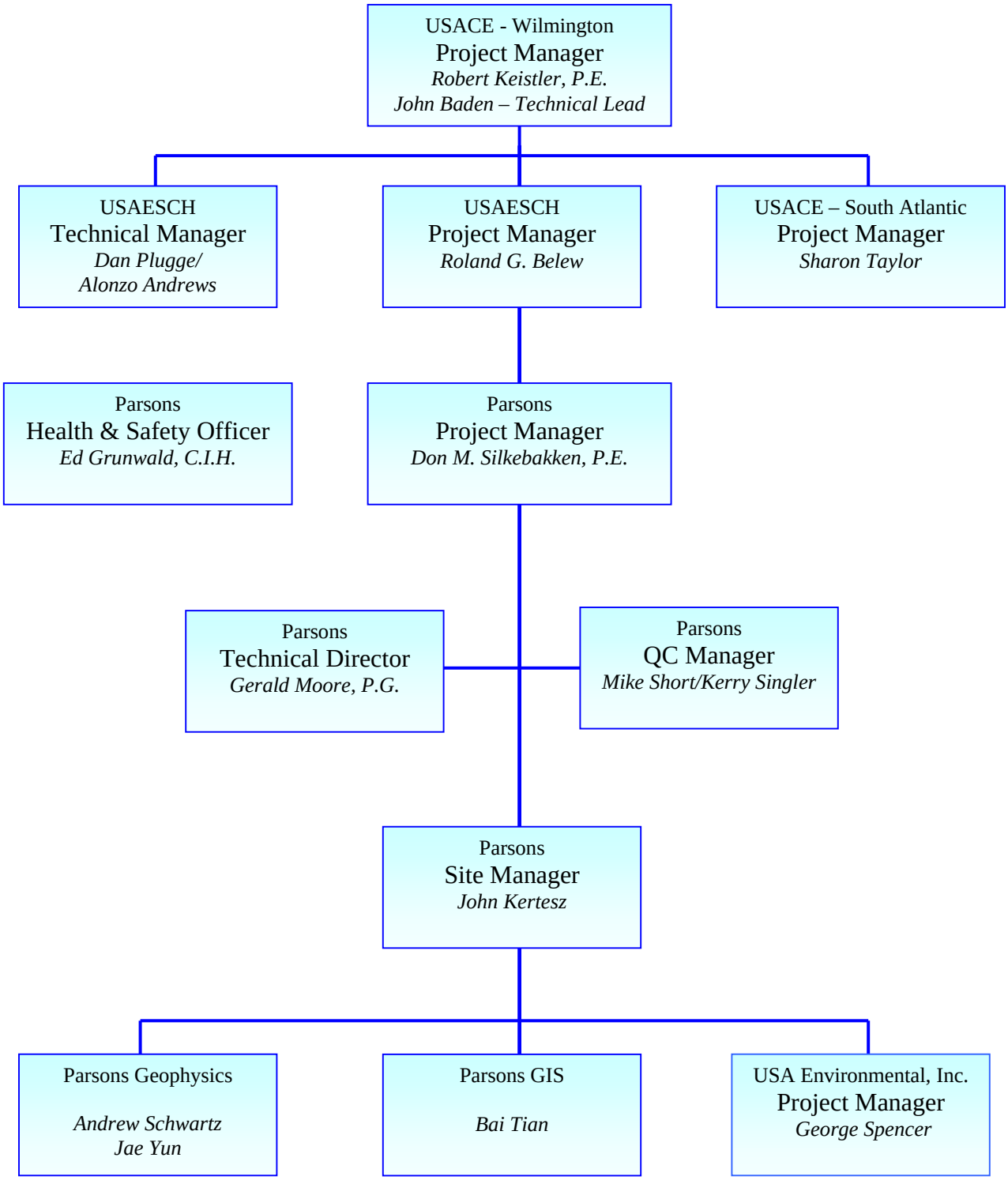
USA was the UXO subcontractor to Parsons. USA provided qualified UXO personnel needed to conduct the field investigation. Services provided by USA included escort and visual OE clearance of areas designated for geophysical investigation and access routes identified by Parsons, and performance of intrusive investigations of anomalies identified and reacquired by Parsons. USA was also responsible for all UXO/OE operations, including handling, detonating, and storage of OE and OE scrap. Parsons was responsible for ensuring and coordinating final disposal of OE scrap. Mr. George Spencer was USA's PM for this project.

1.5 PROJECT OBJECTIVES

The objective of this task order is for Parsons to prepare an EE/CA report (this document) containing the following elements:

- Characterization of OE nature, location and concentration.
- A description of the OE-related hazards affecting human use of the site.
- Identification and analysis of reasonable risk management alternatives.
- A convenient record of the process for use in final decision-making and judicial review, if necessary.

FIGURE 1.1
ORGANIZATIONAL STRUCTURE FOR
FORMER CAMP BUTNER EE/CA



CHAPTER 2
SITE DESCRIPTION AND HISTORY

2.1 LOCATION

The former Camp Butner, consists of approximately 40,384 acres and encompasses portions of Person, Durham, and Granville Counties, North Carolina (Figure 2.1). The boundary of the site is loosely defined by the old Range Road, which makes a contiguous loop around the site although identified by multiple names and County designations. Approximately 75 percent of the Camp is located within Granville County. The northern and eastern boundary roughly follows Range Road (County Road 1126). County Road 1721 (continuation of Range Road into Person County) defines the western boundary and continues southward onto Cassam Road. The Southern Railroad defines the southeastern border. A general layout map of the former Camp Butner Site is presented in Figure 2.2.

2.2 PHYSICAL DESCRIPTION

2.2.1 Terrain and Vegetation

2.2.1.1 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 NCNG property. The most common land use is agriculture and forestry. This combination of land use is typified by cropland clearings within expanses of woodland.

2.2.1.2 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. Presently, forested areas in the northeastern region of the site are undergoing commercial logging that has denuded the landscape and created hummocky terrain. Vegetation in farmed areas consists of grasses and agricultural crops, often tobacco.

2.2.2 Geologic and Soil Conditions

Former Camp Butner is located within the Durham Sub-basin. The predominate bedrock formation is Arkosic Sandstone. The sandstone is tan in color, medium to very coarse grained, and contains mica. The soil is from the Triassic Age and is an acidic bedrock material. The Site, located within the White Store-Creedmoor soil association, has gently sloping to moderately steep, moderately well drained (sandy loam) soils with a subsoil of firm clay.

2.2.3 Climate

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 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.

2.3 HISTORY

2.3.1 On February 12, 1942, the War Department issued an order for the acquisition of land near the Durham, North Carolina area to be used as a training and cantonment facility during World War II. At the time, the land use was primarily low density residential in nature. The original authorization was for 60,000 acres of real property; however, the actual amount of land acquired was approximately 40,384.39 acres.

2.3.2 The land to establish Camp Butner was obtained by the War Department from private landowners primarily by fee with only 128.40 acres in easements, 2.51 acres in licenses, and 52.40 acres in leased tracts. Although the Camp was considered active until 1946, its use for training exercises lasted only for approximately 18 months from early 1942 to June 1943.

2.3.3 The construction of Camp Butner began February 25, 1942 and proceeded at a high rate until its completion in August of the same year. The camp was primarily established for the training of infantry divisions (including 78th, 89th, and 4th) and miscellaneous artillery and engineering units. Camp Butner was designed to house up to 40,000 troops. In addition to infantry training, the site was the location of the one of the Army's largest general and convalescent hospitals and the War Department's Army Redeployment Center.

2.3.4 The first Division to arrive at Camp Butner was the 78th "Lightning" Division on August 15, 1942. Soon after that, other Divisions began arriving. The primary mission of Camp Butner was to train combat troops for deployment and redeployment overseas. There were approximately 15 live-fire ammunition-training ranges encompassing a combined approximately 23,000 acres. Other training ranges included a grenade range, a 1000-inch range, a gas chamber, and a flame-thrower training pad. There was also an ammunition storage area. In September of 1943, the first Prisoners of War (POWs) arrived at the camp. Figure 2.3 identifies the historical military land use for the Camp.

2.3.5 On January 31, 1947, the War Department declared Camp Butner excess. At that time, the Federal government was negotiating with the State of North Carolina for a lease on the hospital. The State was interested in using the hospital as a State mental hospital. The State was also negotiating the purchase of 10,000 acres to be used to support the hospital. On November 3, 1947, the State purchased the hospital, later named the John Umstead Hospital, and 1,600 acres of the cantonment area to be used for various

projects and agricultural development. The NCNG was conveyed 4,750 acres of the former Camp Butner for training purposes.

2.3.6 After Camp Butner was declared surplus, dedudding operations were initially conducted in 1947 and continued through 1950. The Recapitulation Dedudding Report presented in the ASR stated that 1366 UXO/OE items had been discovered and destroyed by the completion of dedudding operations. Six areas were identified during dedudding inspections as warranting land restrictions to 'surface use only' due to the numerous amount of HE duds found. These six areas (Figure 2.3) identified were defined as the following: Area A (an artillery impact area); Area B (a bazooka and rifle grenade impact area); Area C (an artillery and rifle grenade impact area); Area D (a moving target area); Area E (a bazooka and rifle grenade impact area); and Area F (a hand grenade court). Much of the property was sold back to the original owners, with provisions outlined in the property deed restricting land use to 'surface use only'.

2.3.7 Periodic inspections of the six areas with land restrictions were conducted between 1958 and 1969. During the inspections and removal of ordnance from the restricted areas other property owners identified ordnance for disposal that had been found in unrestricted areas. Table 2.1 lists the type of ordnance items found during the annual/semiannual inspections of restricted areas (as well as general findings within unrestricted areas) at the former Camp Butner Site:

TABLE 2.1
FORMER CAMP BUTNER
ANNUAL INSPECTION (DEDUDDING) FINDINGS
(1958 – 1969)

AREA RESTRICTED TO 'SURFACE USE ONLY'	TYPE OF UXO RECOVERED
Area A	Rifle grenade, 2.36-inch rockets, 37mm, 40mm, 81mm mortar, 105mm, 155mm, and 240mm projectiles
Area B	2.36-inch rockets and 81mm mortars
Area C	81mm mortars, 37mm, 105mm, 155mm, and 240mm projectiles
Area D	2.36-inch rocket, 37mm and 40mm projectiles
Area E	2.36-inch rocket
Area F	No findings reported
Other "Unrestricted" Areas	Hand grenades, 37mm, 40mm, 60mm, 81mm, 105mm, and 155mm projectiles and 2.36-inch rockets

2.3.8 The ordnance used during training at Camp Butner included small arms, grenades, artillery rounds ranging from 20mm through 240mm, and various initiating and priming material used as obstacles and minefield clearing devices. UXO/OE recoveries made during the dedudding operations confirmed historic munitions use. UXO/OE that may be encountered within the site include: 2.36-inch rockets (practice and HE), rifle and hand grenades, 20mm through 240mm HE projectiles, 60mm and 81mm mortars, anti-personnel practice mines, and demolition items to include TNT.

2.4 DEMOGRAPHIC PROFILE

2.4.1 The 2000 census (US Census Bureau) estimates the population of the Town of Butner at 5,792 and for the County of Granville 48,498. According to the 2000 census estimates for Granville County, population by gender is 52.5% male and 47.5% female; population by race is 60.7% white, 34.9% black or African American, 4% Hispanic or Latino, 0.5% American Indian and Alaska Native, and 0.4% Asian. The largest population by age is between 35 to 44 years with a median age of 36.2 years. The 2000 census for Granville County determined an average household size of 2.58 persons, with a median household annual income of $39,965.

2.4.2 An estimated population growth rate of 17.6% is expected for Granville County (within which the majority of the areas of interest [AOIs] reside) between the years 2005 and 2015. Projected economic development for Granville County indicates an increase in total annual earnings by 29.8% and a rise in employment of 11.6%. Manufacturing is predicted to remain the leading industry in Granville County over the next ten years. Over the same time period, agricultural production and employment are forecasted to slow, although earnings are still expected to increase (Holland, 2002). In general, indicators show moderate regional economic and development growth in and around Granville County over the next ten years.

2.5 CURRENT AND FUTURE LAND USE

2.5.1 The current stakeholders within the former Camp Butner Site include:

- North Carolina Department of Agriculture and Consumer Services - operates Umstead Farm Unit (4,200 acres);
- North Carolina State University – operates Beef Cattle Field Laboratory (1,300 acres);
- NCNG Training Site (4,750 acres);
- State Department of Corrections – operates Polk Youth Institution and Umstead Correctional Center (160 acres);
- State Department of Health and Human Services – operates John Umstead State Hospital and Murdoch Center (394 acres);
- U.S. Army Corps of Engineers – northern part of Falls Lake State Park and Waterfowl Impoundment Reserve (2300 acres);
- Federal Government – operates four Federal Correctional Complexes comprised of a correctional facility and federal hospital (770 acres); and
- Various private landowners.

2.5.2 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 use assignment for the areas of the site encompassed by Durham, Granville, and Person Counties are predominantly agriculture / open space and residential / agriculture (>5 acres) (Holland, 2002). 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 manifesting along main roads. The

majority of these parcels are multi-use for a combination of agricultural and residential purposes.

2.5.3 Current residential development is encroaching in areas to the south and stretching north along the eastern boundary of the site. Sprawling development will continue to be experienced in these regions due to migration from Durham and Wake Counties. With an estimated population growth rate of 17.6% for Granville County forecasted by 2015, the projected housing development will increase as well by an estimated 1,748 additional housing units by 2010 (Holland, 2002). The long-range master plan for the Town of Butner predicts an additional 1,850 acres of residential land will be developed by 2020 (OBrien/Atkins, 1998). The majority of residential development in Granville County is expected to take place in the Butner and Creedmoor areas. As growth and residential development continue throughout the region, land used for agriculture and forestry will consequently diminish.

2.6 PREVIOUS INVESTIGATIONS

2.6.1 DERP-FUDS Field Inspection for Preliminary Assessment

2.6.1.1 During March 1990 USACE CESAW conducted a field inspection of the former Camp Butner to gather data regarding potential applicability of the Defense Environmental Restoration Program – Formerly Used Defense Sites (DERP-FUDS) (USACE, 1990a). Historical documentation of inspections of restricted areas and dedudding reports were reviewed and numerous interviews were conducted. A summary of the findings include:

- Identification of a Final Ownership Map of Camp Butner showing the dedudding operations as of April 6, 1950.
- Confirmation that ordnance has been periodically found within the former ranges and Fort Bragg explosives ordnance disposal (EOD) has been responding.
- Personnel interviewed from the Federal Correctional Institution stated they knew of no reports of ordnance being found on their facility. A POW camp was previously located at this location.
- The largest round reportedly used at the Camp was a 240mm projectile.
- Three tear gas chambers existed at the facility.
- Lightning Lake may have a military trash dump beneath it.

2.6.1.2 The report (included as part of the ASR and available in the project Administrative Record) concluded that “ordnance is a major problem” and that “there are ranges with impact areas for artillery, bazooka, rifle grenades, moving target, rifle, pistol, mortars, rockets, and hand grenades that are not fenced or marked as dangerous areas.” The report estimated “the number of rounds per acre” at “10 to 100”. Action items identified included preparation of an Inventory Project Report (INPR) and a risk assessment as well as follow-up phone calls to several interviewees.

2.6.2 Findings and Determination of Eligibility

Under the DERP, CESAW prepared a Findings and Determination of Eligibility (FDE) for the former Camp Butner in July 1990 (USACE, 1990b). The report confirmed that the Camp was formerly used by DoD and eligible for DERP FUDS consideration. A risk assessment code (RAC) score of 4 (further action and completion of INPR recommended) was assigned to the Camp as a whole. The report noted the establishment of deed restrictions on the much of the property prior to sale, as well as area restrictions. Government inspections were conducted at the site until 1973. In October 1990 the INPR was completed. The preliminary assessment recommended two projects for consideration. This resulted in the EE/CA investigation (Project Number I04NC000902) conducted by Parsons, as well as a recommendation for Hazardous Toxic Waste (HTW) Project (Project Number I04NC000901). The HTW project was an investigation of the Lighting Lake Area. A letter dated January 5, 1999 from the State of North Carolina concurred with the classification of the HTW site as a “No Further Action Site".

2.6.3 1992 Site Investigation Report

A site investigation was conducted by Black &Veech Waste Science and Technology Corporation for the USACE Savannah District dated May 26, 1992. This investigation addressed the Camp Butner Landfill at the bottom of Lightning Lake. The landfill site was part of the former Camp Butner and designated for disposal of excess brass and ammunition that could not be packed for shipment when the 78th Division transferred to Europe. The report included background information, remedial investigation results, and qualitative risk factors at the landfill site (ASR).

2.6.4 1993 Archives Search Report (ASR)

In September of 1993 the USACE, Rock Island District, conducted a records search and site inspection for the Camp. The final report, the ASR, documents the extent and nature of their findings of UXO/OE contamination (USACE, 1997/2003). The former Camp Butner was divided into 6 areas for evaluation purposes (Figure 2.4). Areas 1 and 4 were classified as having “confirmed” ordnance present. Areas 2 and 3 were classified as “potential” areas for ordnance present. Area 5 was identified as “uncontaminated” and Area 6, which is currently used as the NCNG Training Center, was not assessed due to its active status and ineligibility for DERP-FUDS. A RAC score was developed based on best available information resulting from record searches, field observations, interviews, and measurements. This information was used to assess risk based upon the potential OE hazards identified at the site. The risk assessment was composed of two factors: hazard severity and hazard probability.

2.6.5 1998 Site Visit

A Site Visit was conducted by USACE on July 21 and 22, 1998 to evaluate the applicability of implementation of a Time Critical Removal Action (TCRA) and to reevaluate the overall RAC score of 1 (assigned through the ASR process). The investigation team visited Areas 1, 2, 3, and 4. The conclusion was a TCRA was not warranted although the RAC score was not modified.

2.6.6 Other Investigations

A Final Environmental Impact Statement was prepared for the U.S. Department of Justice, Federal Bureau of Prisons in May 1992. This report provided an assessment of the environmental consequences of a proposed action to expand the existing Federal Correctional Institution.

2.6.7 2000 Site Visit

Parsons conducted a Site Visit between June 5 and 7, 2000 (Parsons, 2000a). The purpose of the Site Visit was to develop a familiarity with the former Camp, visually inspect areas identified as confirmed or potentially contaminated with OE in the ASR, and photograph the AOIs for the potential EE/CA. In addition, the intention was to qualitatively evaluate applicability of various geophysical approaches for implementation during the EE/CA.

2.6.8 2001 Topographic Engineering Center (TEC) Report

Maps created and produced by the U.S. Army Corps of Engineers, Engineer Research and Development Center, Topographic Engineering Center (TEC), have been compiled in a report following evaluation of historic aerial photographs of the former Camp Butner (USACE, 2001a). Although subjective, this process identified potential ground scars and impact areas. This information was used in the preparation of the project Work Plan to support or refute the locations of suspect ranges impact areas as well as aid in the selection of grid and transect locations (Parsons, 2002). Ground scars identified by TEC could represent ill-defined impact craters or be the result of otherwise benign military activity to include general construction, logging, small arms ranges, obstacle courses, or a variety of other uses. They only suggest activity at the location was occurring during the active military occupation of the facility. Major impact areas identified by TEC confirm the usage and configuration of many suspect firing ranges described in the ASR (USACE, 1997/2003).

2.6.9 2003 ASR Supplement

In 2003 the USACE, Rock Island District, prepared a supplement to the existing ASR in support of preparation of the Military Munitions Response (MMR) Range Inventory (USACE, 2003). The former Camp was divided into five primary areas (encompassing multiple ranges). All of these areas were previously documented in the original ASR (and considered during this EE/CA) only the groupings were revised to fit the input and evaluation criteria requirements of the MMR database. Subchapters 3.2 and 3.5 provide details of the EE/CA range designations. The MMR groupings are presented below:

- Gas Chamber
- Flamethrower Range
- Hand Grenade Range
- Range Complex 1 (South of Enon Road and North of Old NC 75/Southern Range Road excluding the NCNG)

- Central Artillery Impact Area
- Rifle Ranges
- Landscape 1000 inch .22 caliber Range
- AA 1000 inch .22 caliber Range
- Pistol Range
- AT 1000 inch .22 caliber Range
- MG 1000 inch .30 caliber Range
- 37mm Range
- 60mm/81mm Mortar Range 1
- 60mm/81mm Mortar Range 2

- Range Complex 2 (North of Enon Road)
  - West Artillery Impact Area
  - Rifle/MG Range 1
  - Rifle/MG Range 2
  - Mock German Village

Aside from the former Gas Chamber, not considered as a potential source of OE contamination, each of the above ranges were included within the EE/CA investigation presented within this document.

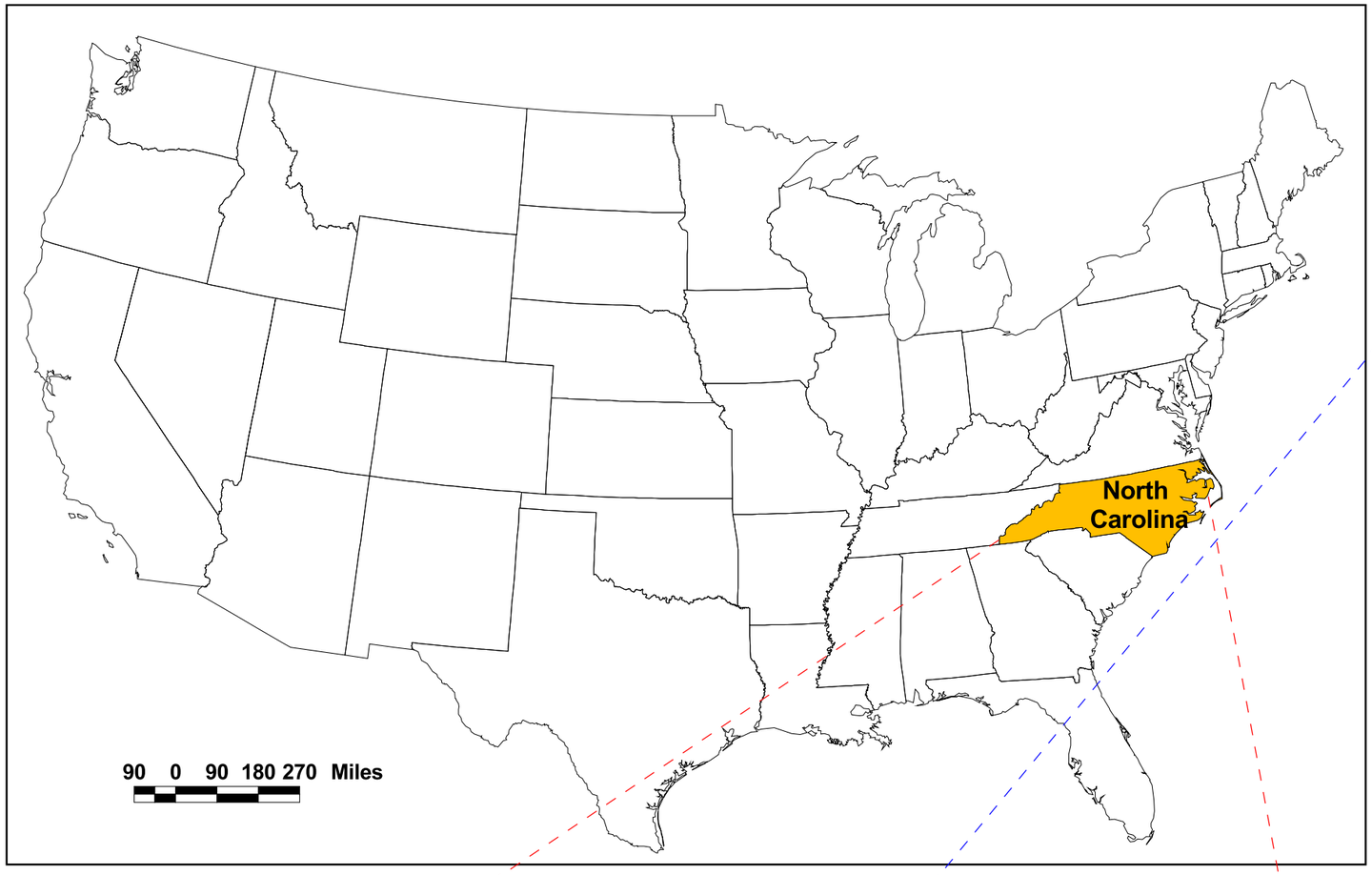
2.7 PREVIOUS REMOVAL ACTIONS

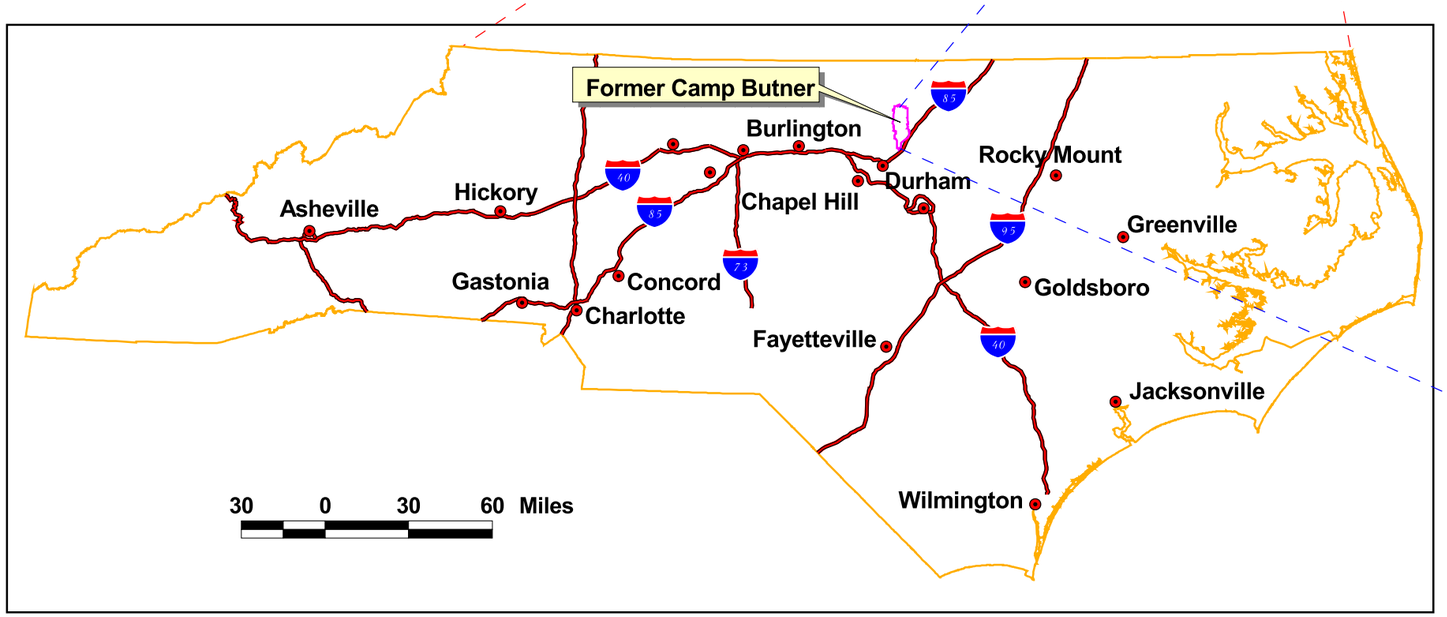
2.7.1 A TCRA was initiated at the Lakeview Subdivision in tandem with the EE/CA investigation for removal of the immediate and imminent danger to public safety posed by the presence of UXO (Parsons, 2003). The removal action was in response to public concern stemming from several UXO findings at Lakeview Subdivision that occurred during this EE/CA investigation. The TCRA was conducted between November 2002 and March 2003 and included land survey, brush clearance, intrusive removal action, and digital geophysical mapping (DGM).

2.7.2 A total of 26 acres were designated for clearance in and around the Lakeview Subdivision for the TCRA, inclusive of a 100-foot buffer zone. Parsons and USA conducted the TCRA inclusive of a clearance of all metallic items comparable in mass or larger than a 37mm projectile in the top 6 inches of soil at the TCRA site. During the clearance, six UXO items were recovered and destroyed including: an electric blasting cap, Mk II hand grenade, 37mm HE projectile, M1 A1 Mine fuze, 2.36-inch rocket motor with fuze, and 2.36-inch HE warhead. Following the clearance, DGM was conducted over the 26-acre site for evaluation as to whether further subsurface removal actions were warranted. The DGM survey conducted after completion of the TCRA suggests that additional subsurface investigation is warranted (Appendix B). The USAESCH reviewed the DGM survey and had the following conclusions:

"The geophysical maps prepared subsequent to field activities confirm the presence of additional metallic debris concentrated within the immediate vicinity of the Cash Property with lesser amounts dispersed throughout the Lakeview Subdivision area. Review of the geophysical data collected, historical

information, utility locations, surface feature maps, and the TCRA excavation results indicate the origin of recovered UXO, OE scrap, and non-OE scrap may be the result of periodic debris disposal in addition to fired projectiles". "The only way to confirm the remaining anomalies are not UXO is to conduct a clearance to depth removal action beginning in the northwest corner of the site in the immediate vicinity of the Cash Property and proceeding grid by grid towards the south and east until no additional UXO are recovered".





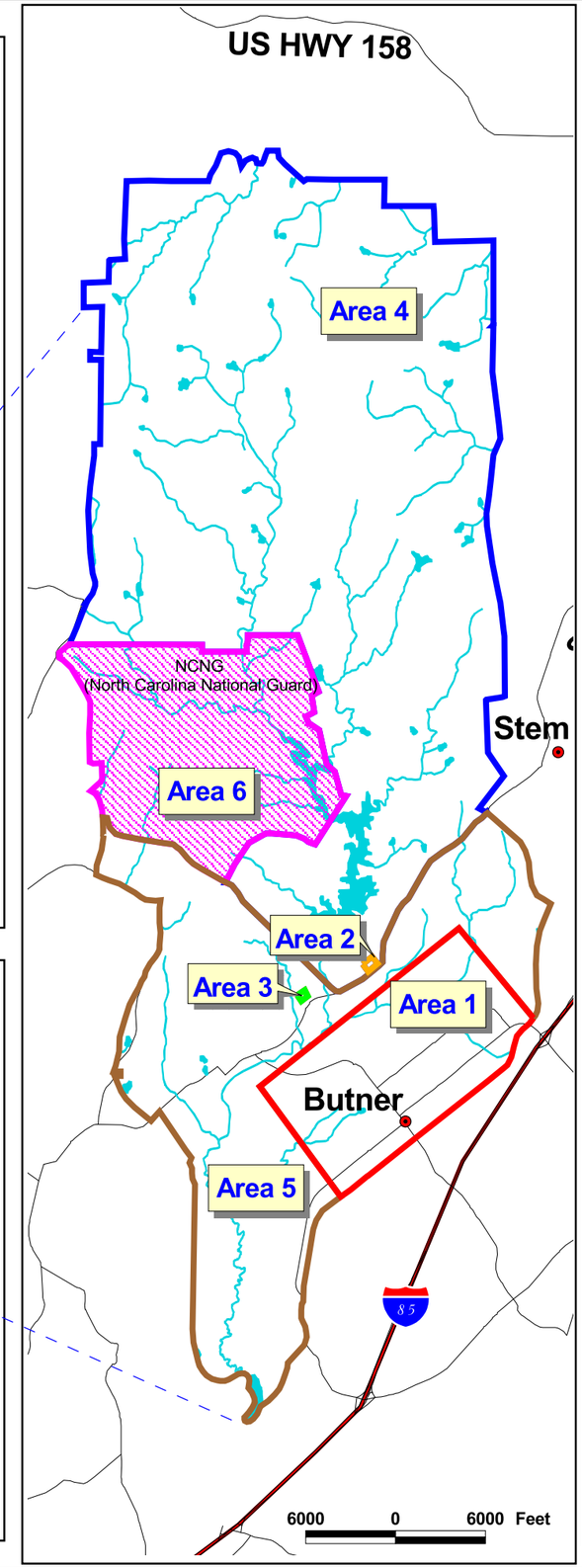


Figure 2.1

General Location Map

Former Camp Butner
Butner, NC

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	General Location Map		
DRAWN BY: BT			
CHECKED BY: JK	SCALE: As Shown	PROJECT NUMBER: 738001	
SUBMITTED BY: DS	DATE: July 2004	PAGE: 2-10	
	FILE: x:\gis\738001\av_project\EECA.apr		

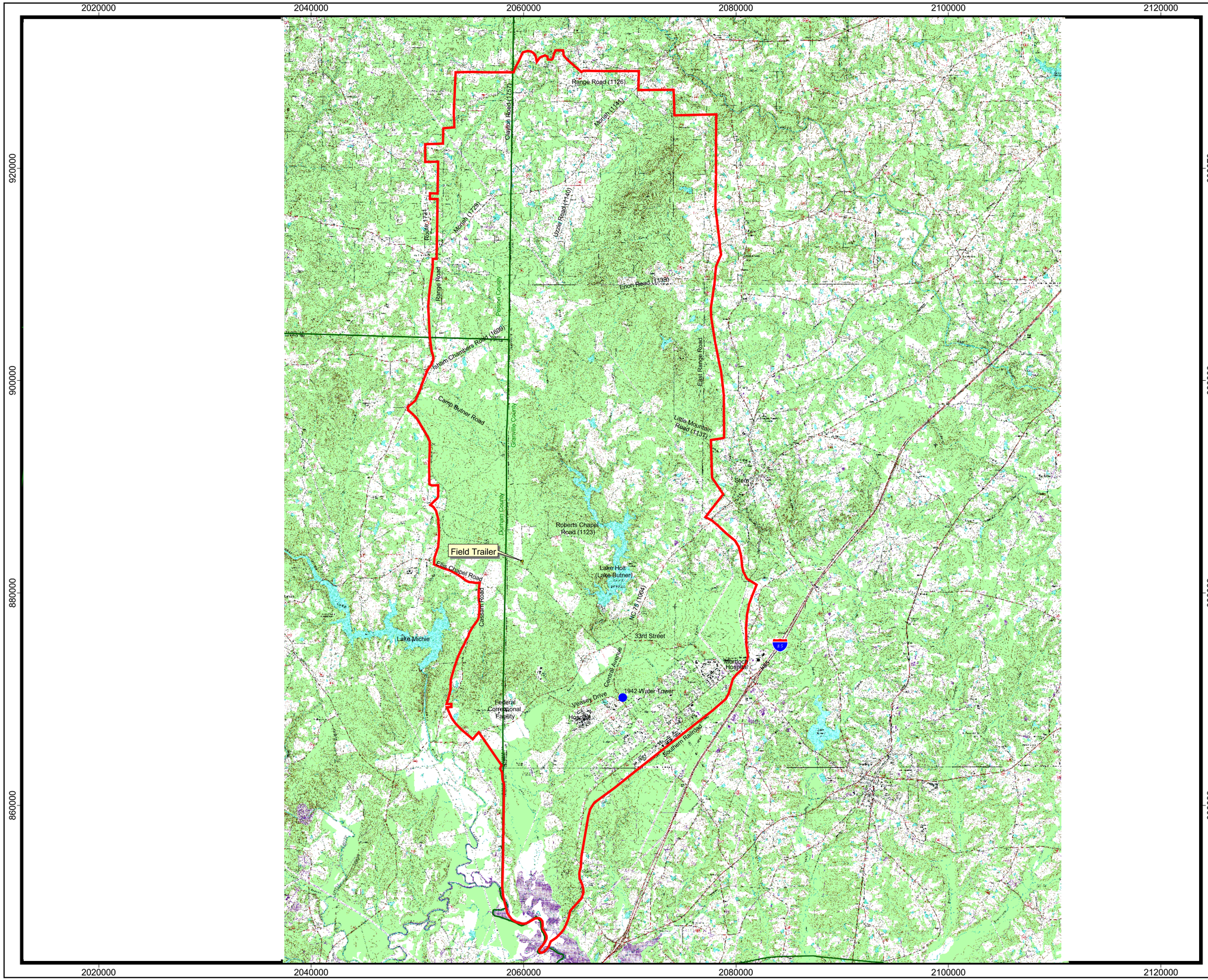


Figure 2.2

Former Camp Butner
Butner, NC

General Layout

Legend

- Former Camp Butner Boundary
- Stream and Waterbody

Map Units: NAD 1983 North Caralina State Plane (Feet)

8500 0 8500 Feet

N

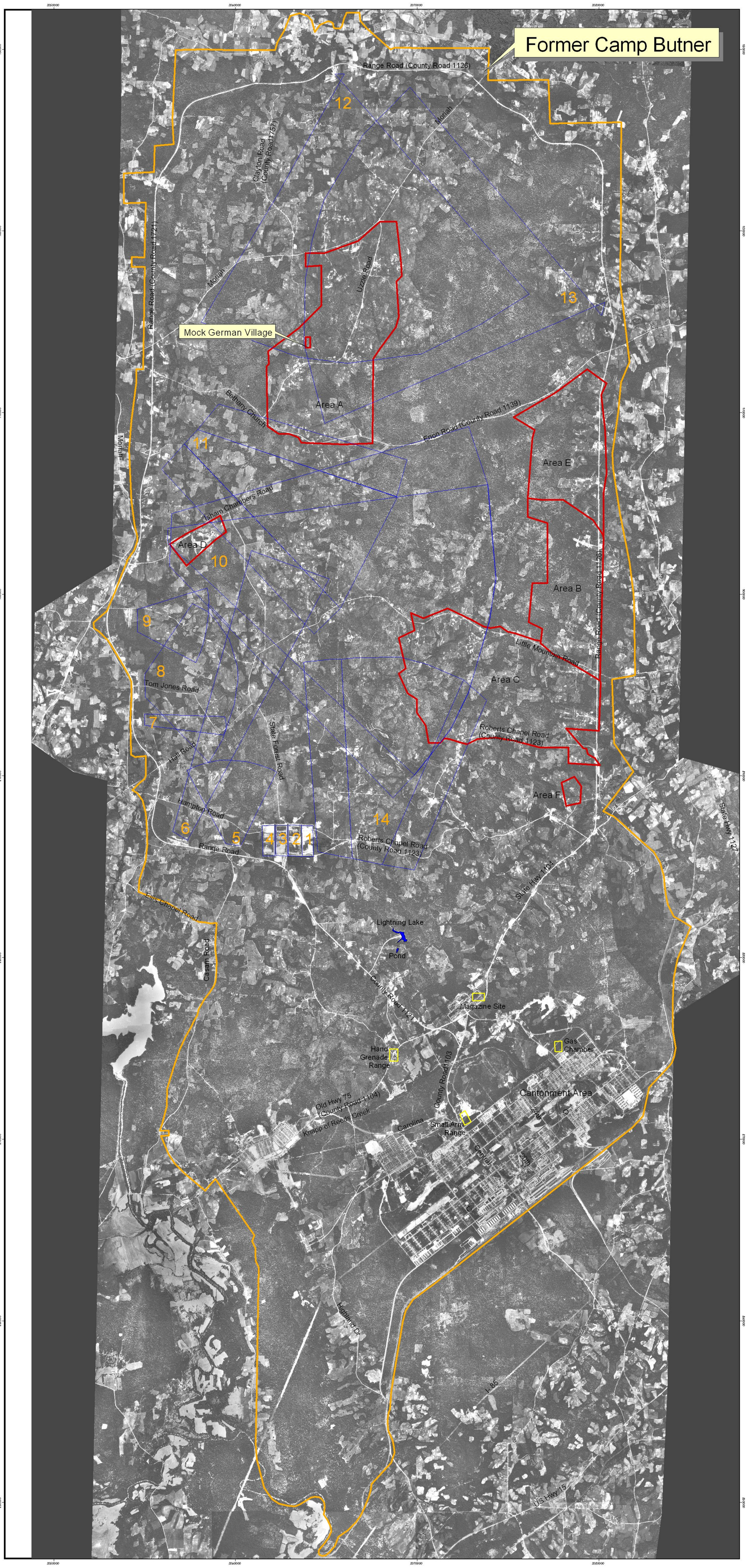
PARSONS	U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE

DESIGNED BY: BT	General Layout		
DRAWN BY: BT			
CHECKED BY: LK	SCALE: 1 inch equals 8,500 feet	PROJECT NUMBER: 738001	
SUBMITTED BY: DS	DATE: July 2004	PAGE NUMBER: 2-11	
	FILE: x:\gis\738001\av_project\TCRA_loc.apr		

Figure 2.3

Historical Military Land Use

Former Camp Butner
Butner, NC



Legend

- Former Camp Butner Boundary
- Historic Designated Range
- Historic Training Area
- Property Deed Restricted Prior to Government Release as "Surface Use Only" (Areas A-F) Due to Extensive Ordnance Presence (See Subchapter 2.3)

A - Artillery Impact Area
B - Bazooka and Rifle Grenade Impact Area
C - Artillery and Rifle Grenade Impact Area
D - Moving Target Area
E - Bazooka and Rifle Grenade Impact Area
F - Hand Grenade Court

List of Ranges:

1-9	Small Arms
10	37 mm
11, 14	Trench Mortar, 60 and 81 mm
12, 13	Heavy Artillery

Site Location in North Carolina

Image Source: 1945 Aerial Photo from TEC

Map Units: NAD 1983 North Carolina State Plane (Feet)

2600 0 2600 5200 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Historical Military Land Use	
DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 2,600 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 2-17
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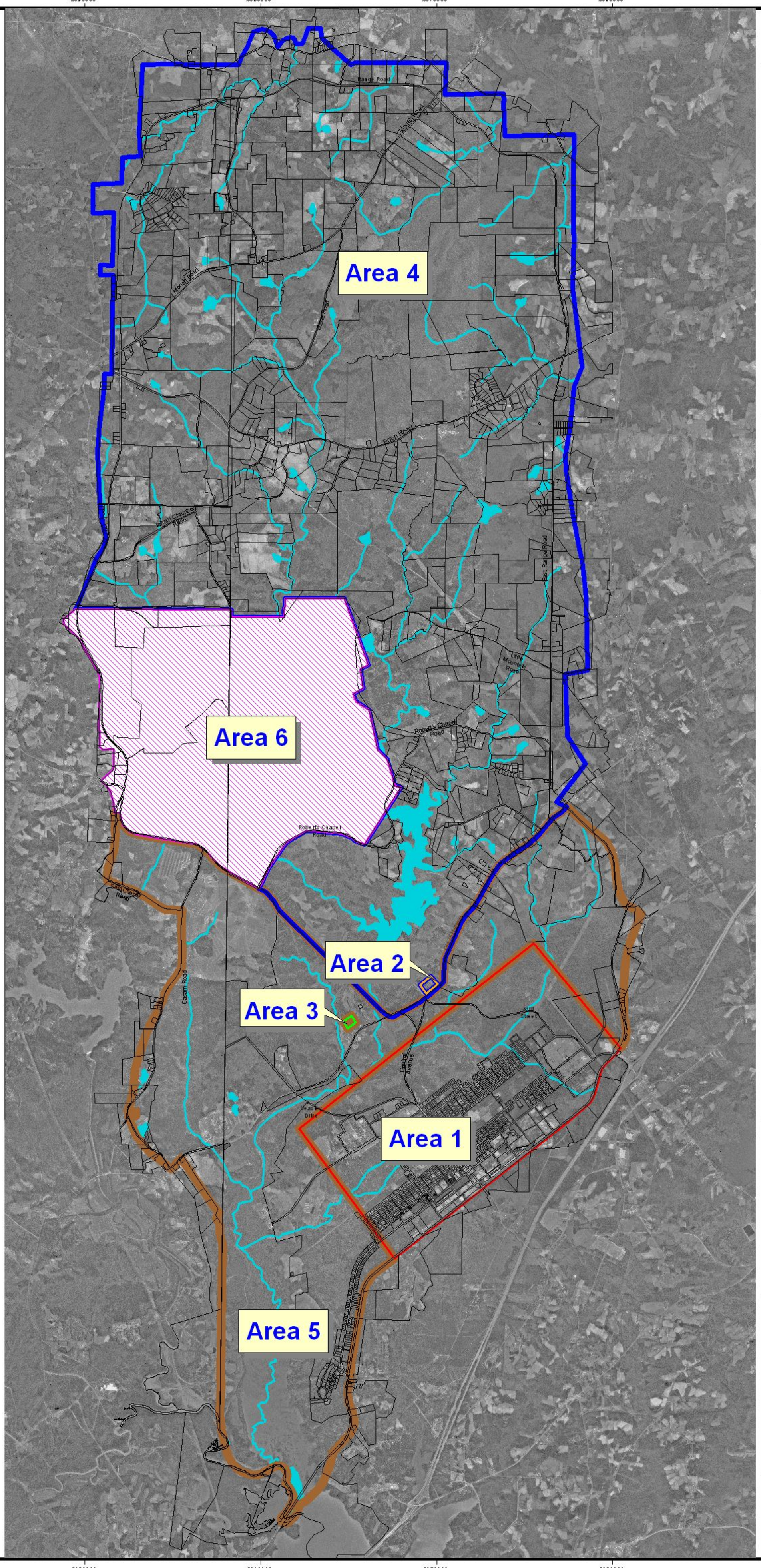


Figure 2.4

ASR-Designated Project Areas

Former Camp Butner
Butner, NC

Legend

- Area 1 - Cantonment Area & Vicinity
- Area 2 - Ammunition Storage Area & Dump
- Area 3 - Grenade Training Ranges
- Area 4 - Ammunition Training Ranges & Impact Area
- Area 5 - Remaining Land
- Area 6 - National Guard Training Center
- Stream and Lake

Site Location in North Carolina

Image Source: 1993 Aerial Photo from TEC

Map Units: NAD 1983 North Carolina State Plane (Feet)

0 5500 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	ASR-Designated Project Areas		
DRAWN BY: BT			
CHECKED BY: JK	SCALE: As Shown	PROJECT NUMBER: 738001	
SUBMITTED BY: DS	DATE: July 2004	PAGE: 2-13	
	FILE: x:\gis\738001\av_project\EECA.apr		

CHAPTER 3
SITE CHARACTERIZATION

3.1 SITE INVESTIGATION

DGM was performed at the former Camp Butner using the EM-61 and EM-61 MK 2 metal detectors to identify and locate surface and subsurface geophysical anomalies for intrusive sampling. A ranking algorithm was developed and applied to the geophysical data in order to select anomalous responses characteristic of suspect ordnance for intrusive investigation (see Subchapter 3.1.4.2). The main objective of geophysical/intrusive investigation is to characterize the nature and extent of UXO/OE at the site and support the risk-based recommendations of OE response alternatives. This chapter describes the geophysical methods and procedures, intrusive results, and the nature and extent of UXO presence.

3.1.1 Instrumentation

Two site-specific geophysical prove-outs were conducted from September 18 through September 22, 2000 and from March 12 through March 16, 2001 to identify the most effective geophysical equipment to be used during the EE/CA geophysical investigation. Based on the analysis of current available geophysical technologies, familiarity with site conditions, and Parsons' experience at other sites, two geophysical methods selected for testing included time domain electromagnetic metal detectors and flux-gate magnetometers. The results from the prove-out demonstrated that the Geonics® EM-61 and EM-61 MK 2 Time Domain Metal Detectors (TDMD) were most effective overall. These instruments were selected (and USAESCH-approved) for use at the former Camp Butner Site based on high detection rates and low false alarm rates (Parsons, 2002). The Schonstedt® Magnetic Locator also indicated acceptable performance and was used for "mag and dig" clearance of a limited number of grids with particularly rough terrain, as described later in this chapter.

3.1.1.1 Geonics® EM-61 TDMD

The EM-61 instrument is a high-sensitivity high-resolution TDMD, which is used to detect both ferrous and non-ferrous metallic objects. A transmitting coil emits a pulsed electromagnetic signal that generates subsurface eddy currents. As the transmitted signal decays in time, a secondary signal is induced within conductive bodies that oppose the change in magnetic flux. The decay rate of the secondary magnetic field depends on the conductivity of the subsurface environment. Receiver coils measure the intensity of the secondary response decay rate by integrating the voltage induced at the receiver coils for a given duration. The EM-61 data logger collects data at automatic time intervals determined by the user. During the EE/CA at the former Camp Butner Site, the EM-61

was operated in a hand-pulled configuration using automatic time intervals for surveying grids. Figure 3.1 presents a photograph showing the usage of the EM-61 at the site.

3.1.1.2 Geonics® EM-61 MK 2 TDMD

The EM-61 MK 2 instrument is a high-sensitivity high-resolution four-channel TDMD. The EM-61 MK 2 operates under the same principles as the standard EM-61, and utilizes the same top and bottom coil system. Receiver coils of the EM-61 MK 2 measure the intensity of the secondary response decay rate in a conductor by integrating the voltage induced in the receiver coils over four different time gates. Data from four channels corresponding to four time gates are recorded to provide a more complete measurement of the response decay rate for improved target characterization. The decay rate is a complex function of the conductivity, magnetic permeability and shape of the target, so analysis of the decay rate could allow discrimination to some degree of the subsurface metallic items. Early time gates enhance the detection of smaller targets; a mid-range time gate (channel 3) is the same time gate used for the standard EM-61 and is useful for comparative analysis. The EM-61 MK 2 was used in the hand-pulled configuration and deployed during Phase I data acquisition (comprising approximately 50% of the geophysical mapping effort). Because the instrument used on-site was a prototype, difficulties arose when instrument components required replacement. The decision was made to discontinue using the EM-61 MK 2 for the standard EM-61 during Phase II. Since both units have a common recording channel data from both instruments can be compared and evaluated.

3.1.1.3 Schonstedt® Magnetic Locator

Schonstedt® Magnetic Locators detect subsurface ferrous metal items. The technology utilizes two fluxgate sensors mounted a fixed distance apart and aligned in a gradiometer configuration. The Schonstedt locator is a hand-held unit that detects changes in the earth's ambient magnetic field caused by ferrous metal (the sensors are fixed and aligned to eliminate a response to the earth's ambient field). The Magnetic Locators generate an audible analog response when the two sensors detect a disturbance of the earth's ambient field associated with a ferrous target. Schonstedt® Magnetic Locators were used by UXO-qualified personnel at the former Camp Butner Site prior to advancement of any stakes, pin flags, or similar subsurface markers, to prescreen anomaly locations for subsequent reacquisition in grids, and for “mag and dig” clearance of a limited number of grids.

3.1.1.4 Trimble® 4700 Real-Time Kinematic (RTK) Total Station Global Positioning System (GPS)

The Trimble® 4700 RTK GPS consists of a high precision rover unit linked by radio to a fixed base station that allows real time acquisition of geodetic data. The Trimble® 4700 RTK GPS is capable of attaining centimeter accuracy dependent on satellite constellation and unobstructed transmission signal path between satellite and ground based receivers. Meandering path surveys were performed using the Trimble® 4700 RTK GPS system in conjunction with the EM61 MK 2, which enabled positioning and geophysical data to be merged real time. Due to mature forest canopy and varying

topography, usage of the Trimble®4700 RTK GPS for meandering path surveys was confined to areas of the site that were generally flat and open/non-vegetated. The Trimble® 4700 RTK GPS was also used for establishing the grid corners and reacquisition of selected geophysical anomalies.

3.1.2 Quality Control of Geophysical Instruments

3.1.2.1 The field crew performed and recorded the following Quality Control (QC) tests for all instruments on a daily basis:

- Static background test twice daily (beginning and end of each day) to record background response for 3 minutes over a quiet area considered to represent known site conditions.

- Static spike test twice daily (beginning and end of each day) to record instrument response over a standard QC item for 3 minutes.

- Latency test was conducted before and after data acquisition in a grid or transect line. The test line was 100 feet or the length of the grid and included a standard QC item (e.g., trailer ball) placed at a known location. The test line was traversed twice, once in each direction that data was to be collected in the grid.

3.1.2.2 Additional QC was achieved by leaving the QC item placed for the latency test within the grid for the duration of data collection. The location of this item was recorded by the field crew and the anomaly response from the QC item was analyzed during the data processing. The response and location of this item within the survey grid provided QC of both instrument functionality and data positioning. On occasion, EM-61 response to the trailer ball was found to vary by more than 25%, and upon review, the variations were found to be due to either varying instrument heights over the trailer ball or differences in the orientation of the trailer ball with respect to the instrument sensors. In all such cases, the data were reviewed by the Senior Project Geophysicist and found to be of good quality and were accepted. Corrective actions were also taken by informing the survey teams of the variations and providing instructions to modify their procedures.

3.1.2.3 The QC test readings taken at the beginning and end of each day and for each grid were compared, and if they differed by more than 25%, then the data were reevaluated and, if necessary, the problem was corrected or the instrument was replaced.

3.1.2.4 Quality Assurance (QA) was conducted by USAESCH on selected grids, unknown to Parsons, to verify instrument response and reacquisition of anomalies. QA was accomplished by the burial of seed items at anonymous grid locations by a USAESCH Geophysicist. Seed items were selected to generate a response characteristic to ordnance likely encountered at the site. Seed items buried within grids intrusively investigated were successfully recovered during the EE/CA investigation.

3.1.3 Geophysical Survey

The geophysical mapping effort conducted at former Camp Butner was performed in two phases. The first phase was conducted between March 26 and July 11, 2001 and the second phase between March 18 and May 24, 2002. The total area geophysically surveyed was approximately 132 acres. A combination of grids and "meandering paths" were used during the geophysical mapping. The locations of the sampling areas were dispersed as detailed in Section 4.2 of the approved project Work Plan (Parsons, 2002). The selection/location process was dynamic and involved a number of factors including statistical validity, representative coverage, biased sampling, available right-of entry grants from property owners, and project team input. Locations were adjusted in the field on occasion due to terrain or vegetation conditions and new information obtained as the result of the ongoing study. Several grids were relocated to properties where UXO was recently found or from comments received at Public Meetings.

3.1.3.1 Grid Survey

3.1.3.1.1 The majority of geophysical mapping was achieved using grid survey techniques. Data was acquired using the hand-pulled EM-61 and EM-61 MK 2, which required an operator to collect data along survey lines within a pre-established grid. The hand-pulled unit consisted of a single set of 0.5-meter by 1-meter coils, with a top and bottom coil separation of 40 centimeters. The unit was pulled from a plastic handle that extended perpendicular from the long axis of the lower coil.

3.1.3.1.2 The grid surveys were conducted by first establishing the corners of a grid using professional land surveyors or qualified Parsons' personnel. Grid corners were surveyed using conventional land survey techniques in conjunction with GPS. To ensure the future reestablishment of each grid at the time of reacquisition and intrusive investigation, wood stakes and metal spikes were inserted at each corner of a grid. A UXO-qualified escort conducted a visual and surface sweep using a Schonstedt magnetic locator over the area where a stake or spike was to be driven prior to insertion. Grid dimensions were generally 100 feet by 100 feet. The grid was divided into parallel lines spaced 2.5 feet apart for EM-61 and EM-61 MK 2 surveys.

3.1.3.1.3 The grid survey method used by the geophysical data collection teams relied on the instrument operator(s) walking straight lines at a constant pace to achieve accurate reacquisition. The geophysical data were collected by traversing these lines with the geophysical survey equipment. During data acquisition, the instrument operator inserted fiducial markers into the data as they were recorded. The fiducial markers were used to reference the data to positional coordinates at the time of processing. Geophysical data were recorded in automatic mode using a polycorder or Pro4000 data logger at a rate of 12 samples per second. The data was initially referenced in local coordinates and translated into U.S. state plane coordinates during the data processing phase. Approximately 118 acres were digitally geophysically mapped using the grid survey method.

3.1.3.2 Meandering Path Survey

Prevailing site conditions limited the application of meandering path surveys due to varying topography and mature tree canopy that limited GPS coverage. Meandering path surveys were selectively conducted in open fields and where satellite reception was unimpeded. The EM-61 MK 2 was used in conjunction with a Trimble 4700 RTK GPS to allow both geophysical and geodetic data streams to be merged during data acquisition. The GPS antenna was set over the center of the coils to capture positional data using a logging rate of one reading per second. The instrument operator then traversed within the limits of the open area using this hand-pulled system. Approximately 9 acres were digitally mapped using the meandering path technique.

3.1.3.3 Analog Detection (Mag and Dig)

In addition to the grid survey techniques, a "mag-and-dig" method was also used during the geophysical investigation. The "mag-and-dig" method was used in two instances: to survey those grids that posed unusually difficult access for the larger EM-61 units; and for grids assigned during the intrusive phase of the investigation. A Schonstedt® Magnetic Locator was used to locate ferrous subsurface anomalies in such grids. Immediately after anomaly identification, UXO-qualified personnel excavated and identified the anomaly sources. In cases where large numbers of anomalies were detected, a method was devised to reduce the digging of non-ordnance anomalies (e.g. ferrous containing rocks). The method involved a UXO-qualified operator sweeping an entire grid and placing a pin flag at each location where a geophysical anomaly was detected. The method required the surveyed grid to be divided into four quadrants from which 7 to 8 anomalies per quadrant were selected for excavation. A total of 30 anomalies were excavated per "mag and dig" grid in this manner. Approximately 5 acres were intrusively investigated using this survey technique.

3.1.4 Anomaly Identification

3.1.4.1 Data Processing

3.1.4.1.1 At the end of each day, the geophysical data were downloaded from the data loggers to the field laptop computer. The downloaded data files (daily static tests, latency tests, and geophysical surveys) were then imported into manufacturer supplied software programs (DAT61™ for Windows for the EM-61 data and DAT61 MKII™ for the EM-61 MK 2). Preprocessing of the transferred data was then performed, which included the adjustment of start, end and fiducial marker positions entered by the instrument operator. Data spikes, defined as a single datum or set of data points that diverge significantly from contiguous values, were edited to ensure that terrain-induced spikes (not representing subsurface metallic debris) were removed. This process involves review and interpretation of field notes and other data by the project geophysicist and results in a clearer picture of anomaly presence.

3.1.4.1.2 Following the preprocessing phase, data files were converted into XYZ format and exported from DAT61™ or DAT61 MKII™ into Geosoft Oasis Montaj for post-processing and graphical display. The geophysical data were leveled, lagged, and

translated from latitude/longitude to state plane coordinates. EM-61 MK 2 data included data from 4 channels, corresponding to the 4 separate time gates, from which the sum was taken to create a fifth channel for use in graphical interpretation. Meandering path survey data did not require translation because it had been previously merged with positional data upon collection. Finally, processed data from the bottom coil response was gridded and graphically displayed in preparation for analysis and interpretation.

3.1.4.2 Anomaly Selection and Ranking

3.1.4.2.1 Interpretation of anomalies was based upon the instrument response from the bottom coil (EM-61) or sum of four channels bottom coil (EM-61 MK 2). The gridded data were analyzed for anomalous responses characteristic of suspect ordnance. Color contour maps were generated from the gridded data to display anomalous features and make anomaly selections. In order for the ranking algorithm to rank reliably, anomalies were selected at the location corresponding to the maximum response value. A database containing the selected anomalies was then compiled in Geosoft and imported into an Access database where a ranking algorithm was then applied.

3.1.4.2.2 The ranking process focused on assigning higher ranks to anomalies that were more likely to be associated with buried or unknown ordnance items, and on reducing the number of false positive anomalies. The ranking process was based on the comparison and analysis of several anomaly characteristics, including: comparing the detected anomaly signals to prove-out signatures of known inert ordnance seed items; comparing the anomaly signals to background levels; and, the analysis of response characteristics. Specifically, the ranking process considered the following criteria:

<u>EM-61 and EM-61 MK 2 Anomaly Ranking Criteria:</u>

- A data channel distinguishable above “background” (location-specific baseline signal influenced by numerous factors including power lines, temperature, soil type, etc.).
- Similarity between anomalous responses on all channels compared to the observed response over inert ordnance seed items detected in the prove-out grid.
- Association between anomalous response characteristics and instrument noise or terrain features.

Once each anomaly was compared against these criteria, an anomaly rank was assigned using the following logic, depending on the instrument used:

<u>EM-61 MK 2 Anomaly Ranking (Phase 1)</u>

- Rank 1: The anomaly responses in all 4 channels was within the ranges of at least two of the inert ordnance seed items detected in the prove-out grid and the anomaly response was distinguishable above background in either all or channels 1 through 3.
- Rank 2: The anomaly responses in all 4 channels were within the ranges of at least one of the inert ordnance seed items detected in the prove-out

grid and an above background response in at least channel 1 or the anomaly responses in all 4 channels were within the ranges of 4 of the inert ordnance seed items detected in the prove-out grid, regardless of whether any of the responses were noticeably above background. In addition upon review, some anomalies that received rankings of 3 were revised to 2 based upon professional judgment.

- Rank 3: All anomalies that do not fall within the criteria of Rank 1 or Rank 2 anomalies and are not associated with items used to establish navigation controls or to perform QC functions.
- Rank 4: The anomaly is associated with an item or object observed on the ground surface or known to exist in the surveyed area (e.g. corner nail, fence post, utility, etc.); or, the anomaly is associated with a QC object.

<u>EM-61 Anomaly Ranking (Phase 2)</u>

- Rank 1a: The anomaly responses can be associated with three or more inert ordnance seed items detected in the prove-out grid and both the top and bottom channel readings were distinguishable above background.
- Rank 1b: The anomaly responses can be associated with at least one of the inert ordnance seed items detected in the prove-out grid and either the bottom or the top and bottom channel readings are distinguishable above background.
- Rank 2: The anomaly responses may be associated with one or more of the inert ordnance seed items detected in the prove-out grid but the bottom channel is not distinguishable above background; or, the anomaly is suspected of being associated with instrument noise or terrain features; or, the anomaly could not be associated with any of the items seeded in the prove-out grid.
- Rank 3: The anomaly is suspected to be the result of geologic features or other cultural features but could not be confirmed through logbook notes.
- Rank 4: The anomaly is associated with an item or object observed on the ground surface or known to exist in the surveyed area as documented in the project logbook (e.g., corner nail, fence post, and other cultural features).

3.1.4.2.3 The ranked anomalies were then categorized by area and area-specific anomaly selections criteria formulated by the project team to enhance anomaly selection on an area-specific basis. The area specific selection criteria considered both the anomaly rank and the type or types of UXO targets that were anticipated in each of the areas of the site. However, due to uncertainty regarding potential multiple use ranges and potential dumpsites, a percentage of anomalies not suspected to be ordnance were investigated at all sites.

3.1.4.2.4 In general 100% of the Rank 1, 1a, and 1b anomalies were selected for intrusive investigation. To account for the possibility that a designated Rank 2 anomaly may be associated with a suspected or an unknown ordnance item, percentages of Rank 2

anomalies were selected for intrusive investigation. A smaller percentage of Rank 3 anomalies were also investigated to validate the anomaly ranking methodology. By definition, Rank 4 anomalies are comprised of known sources that did not warrant investigation.

3.1.4.2.5 The cumulative area geophysically investigated at the former Camp Butner Site was approximately 132 acres, inclusive of "mag-and-dig" acreage. Final analysis from the geophysical mapping effort identified 10,743 Phase 1 anomalies and 4,185 Phase 2 anomalies. Based on the area selection criteria, a total of 8,545 Phase 1 anomalies were selected for intrusive investigation, inclusive of all Rank 1 anomalies and percentages of Rank 2 and 3. Similarly, the selection criteria applied to the Phase 2 ranked anomalies identified a total of 3,086 anomalies for investigation. Due to the relatively low number of Rank 2 and Rank 3 anomalies (707) in Phase 2, it was considered prudent by the project team to investigate 100% of the Phase 2 anomalies rather than select percentages by area for investigation as was done in Phase 1. A total of 570 "mag-and-dig" anomalies were also intrusively investigated as part of Phase 2.

3.1.5 Anomaly Dig Sheets

All anomalies identified during the field investigation were uniquely numbered and listed on Anomaly Dig Sheets. The unique number included an anomaly identification (ID), which reflected the grid ID and the sequential anomaly ID for that grid. The Anomaly Dig Sheet also included the location of the anomaly in either local grid coordinate system or North Carolina State plane coordinates, as well as the millivolt response of the peak signal associated with the anomaly.

3.1.6 Anomaly Reacquisition

Approximately 11,631 (8545 Phase 1 and 3086 Phase 2) anomalies were selected as candidates for reacquisition and subsequent intrusive investigation based on application of the anomaly ranking and selection strategy. When reacquiring grid anomalies, measuring tapes were initially pulled across the length (y-axis) of the grid; one measuring tape was pulled from the southwest to northwest corner and another from the southeast to northeast corner. A third measuring tape was then pulled across the width (x-axis) of the grid and held at each end by a member of the dig team in order to facilitate movement of the tape measure along the y-axis. A non-metallic pin flag (displaying the anomaly ID) was then placed at the point of intersection of the x and y-axes measuring tapes, as indicated in local coordinates on the dig sheet. Finally, the precise anomaly location was refined using the Schonstedt Magnetic Locator.

3.1.7 Intrusive Investigation

3.1.7.1 The intrusive investigation at former Camp Butner was conducted from August 5 through October 17, 2002. A total of 7071 anomalies were intrusively investigated including 6501 anomalies selected from the digitally mapped geophysical data and the 570 anomalies identified during the "mag-and-dig" survey. Some anomalies, although selected for investigation via the screening process identified above,

could not be excavated. Although not all inclusive, reasons for deletion of a selected anomaly from the investigation included:

- The area or subarea was considered characterized (for example, many anomalies identified for investigation in Area 3 – Grenade Training Range were not investigated following project team concurrence that the findings indicated that a grenade range was never present at the location).

- The area digitally mapped was subsequently covered by an agricultural crop and the property owner would not allow the intrusive investigation to proceed.

- UXO was present within a grid or group of grids. In such cases the grid is determined to be characterized and all remaining anomalies are deleted from further investigation.

- Evacuation refusal by resident within the minimum separation distance (MSD) for the area of concern.

- High concentration of anomalies in a low-likelihood area (for example, due to the numerous anomalies in Area 1 – Cantonment Area and the absence of any historical firing fans, anomalies were eliminated when present in large clusters). Anomalies displaying significantly large readings, representative of potential burial areas, were investigated.

3.1.7.2 The Parsons project geophysicist compared the findings from each intrusively investigated anomaly (with the exception of "mag-and-dig" anomalies) with the maximum amplitude originally recorded by the geophysical instrument to ensure the item recovered was reasonable for the reading. If the item excavated was not consistent with the selected anomaly data, further investigation of the anomaly location was conducted.

3.1.7.3 All 7071 anomalies intrusively investigated were excavated by UXO-qualified personnel. During the intrusive excavation, each anomaly was treated as a suspect UXO/OE item until it was determined otherwise. Occasionally, intrusive investigation teams could not identify any metallic objects within the "critical radius" (three feet for grids, five feet for meandering path) at an anomaly location. These locations were designated as "false positives" (shown as "no contact" on the dig sheets). Site wide, 390 "false positives" (6%) were identified from the 6,501 anomalies selected from the digitally recorded data. The presence of some "false positives" is inherent in geophysical/intrusive investigations; with 15% considered the maximum acceptable occurrence level (USACE Data Item Description [DID] OE-005-05, March 2000, paragraph 10.4.3). Many reasons exist for the presence of "false positives" including residual rust in the soil, proximity of power lines, metallic surface debris moved after initial survey, rough terrain causing equipment jolts, etc. None of the "mag-and-dig" anomalies, by definition, resulted in a "false positive."

3.1.7.4 After an anomaly was excavated, the intrusive investigation team recorded the anomaly type, a brief description of their finding(s), the anomaly depth and any actions taken. All of this information was recorded on the Anomaly Dig Sheet. The available choices for anomaly types were predetermined as UXO, Ordnance-Related Scrap, Non Ordnance-Related Scrap, False Positive, and Other. In addition, the project geophysicist continually compared the actual findings with the anticipated findings given the anomaly rank and signature. All of the UXO items found as a result of interpretation of DGM survey were Rank 1 anomalies, thus validating the selection scheme. Conversely, several thousand investigated Rank 1 anomalies were not UXO. Further, OE scrap items (indicative of potential UXO presence) cannot be similarly ranked due to their variability in size and shape.

3.1.7.5 The anomaly types identified on the Anomaly Dig Sheets are briefly described in the following sub-chapters.

3.1.7.1 Unexploded Ordnance (UXO)

Anomalies were identified as UXO (noted as "U" in the Anomaly Dig Sheets) if the recovered item was "a military munition that contains explosive, pyrotechnic, or a chemical agent and has been primed, fuzed, armed, or otherwise prepared for action, and which has been fired, placed, dropped, launched, projected, and remains unexploded by design or malfunction" (USACE, 1998b).

3.1.7.2 Ordnance Scrap (OE Scrap)

Anomalies were identified as Ordnance Scrap items (noted as "OES" in the Anomaly Dig Sheets), if the recovered item was "a military munition or component thereof which contains no explosive, pyrotechnic, or chemical agent. Fragments of military munitions, which have functioned as designed or were destroyed, are ordnance scrap if they have no explosive, pyrotechnic, or chemical filler." (USACE, 1998b).

3.1.7.3 Other

By definition, anomalies identified as non-munitions found at ordnance sites are designated as Other (USACE, 1998b). Due to the geologic conditions and the high number of anomalies attributed to iron-bearing rocks, the Other category was sub-divided as described below to distinguish between man-made items and geologic conditions.

3.1.7.3.1 Non Ordnance-Related Scrap (NOES)

Anomalies were identified as Non Ordnance-Related Scrap (noted as "NOES" in the Anomaly Dig Sheets), if the recovered items were not related to any ammunition and/or ammunition components. These items included metal scrap such as nails, chains, cables, metal wire, and pipes.

3.1.7.3.2 Geological Interference

Anomalies were identified as geological interference (noted as "O" in the dig sheets), if the recovered items were not related to ammunition nor were they man-made

metallic debris. These items included materials such as iron-bearing rock (ubiquitous in the area), ferrous soil with no visible metallic item, and any item not fitting one of the categories above.

3.1.7.4 False Positive

Anomalies were identified as False Positive (noted as "FP" in the dig sheets), if no discernable metallic objects were identified at the anomaly excavation location and the magnetometer did not display an audible signal either at the triangulated location or in the general vicinity (approximate 5 foot radius around the pin-flagged location).

3.1.8 Intrusive Investigation Findings

3.1.8.1 A total of thirteen UXO items were recovered during the EE/CA investigation, as summarized on Table 3.1. In addition, 6 UXO were recovered during the TCRA as described in Subchapter 2.7. A total of 1491 out of the 7,071 anomalies intrusively investigated during the EE/CA contained items designated by the intrusive field teams as OE Scrap. A table summarizing all anomaly findings is presented in Appendix C.

3.1.8.2 Following the identification and removal of the anomaly, the excavated area was backfilled and restored to its original pre-intrusive condition. Upon completing the intrusive investigation at the former Camp Butner Site, QC checks were performed in accordance with the approved Work Plan procedures [Parsons, 2002].

3.1.9 Recovered UXO

UXO recovered during the EE/CA investigation at the former Camp Butner Site included one 155mm projectile, two 105mm projectiles, a 57mm projectile, three 2.36-inch bazooka rockets, three 37mm projectiles, Mk II hand grenade, M52-series nose fuze, and M1 practice mine with spotting charge and fuze. Additionally, 6 UXO were recovered during the TCRA at the Lakeview Subdivision. A list of the UXO items recovered during the EE/CA and TCRA, as well as the corresponding grid IDs and depths of findings are tabulated in Table 3.1. Discussion of the UXO items identified at the former Camp Butner Site is presented in Subchapter 3.3.

3.1.10 OE Scrap Disposal

At the completion of the EE/CA, the recovered OE scrap items were inspected by the Parsons UXO Safety Officer and the USA Senior UXO Supervisor (SUXOS) and certified as non-hazardous scrap and disposed of through Swartz and Sons, Inc. in Durham, NC. A DoD Form 1348-1A was completed for the OE scrap items turned in to the scrap metal dealer. The DoD Form 1348-1A, signed by the USA SUXOS and the Parsons Safety Officer, is provided in Appendix D.

TABLE 3.1
UXO RECOVERED AND DETONATED (EE/CA AND TCRA)
CAMP BUTNER SITE, DURHAM/GRANVILLE/PERSON COUNTIES, NC

Grid ID	Depth (inches)	UXO Item	Comments	Ordnance Scrap Findings[1]	Map Location[2]	Number of OE Scrap Items
A1G0209 (EE/CA)	1	Mk II hand grenade	Detonated	Two M15 grenades	D9	2
A1G0211 (EE/CA)	10	M1 practice mine with spotting charge and fuze	Detonated	NA	D9	0
A4G0020 (EE/CA)	3	105mm projectile unfuzed[3]	Detonated	Two M51 fuzes and HE fragments	C3	28
A4G0071 (EE/CA)	30	155mm shrapnel round unfuzed with expelling charge[3]	Detonated	155mm base plate and HE fragments	C3	22
A4G0093 (EE/CA)	10	2.36-inch warhead unfuzed[3]	Detonated	HE fragments	C2	4
A4G0284 (EE/CA)	3	M52 Series nose fuze	Detonated	HE fragments	C6	34
A4G0366 (EE/CA)	6	57mm HE fuzed	Detonated	57mm AP-T	C5	1
A4G0402 (EE/CA)	1	37mm HE fuzed	Detonated	NA	B5	0
A4G0418 (EE/CA)	2	37mm HE fuzed	Detonated	NA	B4	0
A4G0525 (EE/CA)	Surface	105mm projectile unfuzed[3]	Detonated	37mm , PTT fuze , 57mm AP-T, and HE fragments	C5	11
A4G1436 (EE/CA)	3	37mm HE fuzed	Detonated	60mm mortar fin	C7	1

TABLE 3.1, CONTINUED
UXO RECOVERED AND DETONATED (EE/CA AND TCRA)
CAMP BUTNER SITE, DURHAM/GRANVILLE/PERSON COUNTIES, NC

Grid ID	Depth (inches)	UXO Item	Comments	Ordnance Scrap Findings[1]	Map Location[2]	Number of OE Scrap Items
A4G1439 (EE/CA)	18	2.36-inch HE	Detonated	HE fragments	D4	2
A4P/3 (EE/CA)	3	2.36-inch HE	Detonated	Two 2.36-inch rockets, two 2.36-inch rocket motors, and M9 rifle grenade	D5	5
334 (TCRA)	6	M1 A1 Landmine fuze	Detonated	NA	C7	0
335 (TCRA)	1	2.36-inch warhead fuzed	Detonated	2.36-inch nose cone and HE fragments	C7	2
349 (TCRA)	4	Mk II hand grenade	Detonated	NA	C7	0
349 (TCRA)	2	37mm HE fuzed	Detonated	NA	C7	0
358 (TCRA)	1	2.36-inch warhead unfuzed[3]	Detonated	2.36-inch rocket motors, 60mm mortar fins and rifle grenade tail boom	C7	7
375 (TCRA)	2	Electric basting cap	Detonated	M1 mine fuzes	C7	2

NA – Not Applicable, AP-T = Armor piercing w/tracer, PTT = Powder Time Train, HE = High Explosive

1 - All "other ordnance-related findings" were determined inert or fully expended and handled as Ordnance and Explosives Scrap (OES).

2 - Map Location identified on Figures 3.2a and 3.2b

3 – This item was not fuzed, however, it was considered hazardous in its recovered state due to the presence of residual explosives and was detonated.

3.2 SOURCE, NATURE, AND EXTENT OF UXO/OE

This chapter provides an overview of the results of the intrusive investigation performed at the former Camp Butner Site. The ASR divided the site into six (6) areas based on several factors including historic military land use, suspect impact or overshoot areas, and property controlled by the NCNG. The AOIs, initially designated as Areas 1 through 6, are shown on Figures 3.2a and 3.2b along with the intrusively sampled grid locations. The property designated as Area 6 (NCNG Training Center) encompasses approximately 4750 acres of training ranges, impact areas, and buffer zones and is owned and operated by the NCNG. Area 6 was not included in the EE/CA investigation due to its current status as an active training range. The results of the EE/CA investigation are presented for each of the remaining five areas discussed in the following paragraphs.

3.2.1 Area 1

3.2.1.1 Area 1, referred to as the Cantonment Area and Vicinity, encompasses approximately 3,300 acres of the east-central portion of the site now known as the unincorporated Town of Butner (Figure 3.3). The Town of Butner consists of a network of roadways historically utilized by the Cantonment and presently providing access to residential communities and institutional facilities. Ranges and training areas known to have been present in Area 1 included a flamethrower range, a small arms range, a 1000-inch range, an ordnance shipping and receiving area, a magazine storage area, and a tear gas chamber (USACE, 1997/2003).

3.2.1.2 The ASR recommended an EE/CA investigation of Area 1 based on the "potential" presence of UXO. Only .30 caliber cartridge cases were discovered during the ASR reconnaissance and no records of OE findings since facility closure were found (USACE, 1997). However, interviews with NCNG personnel and other sources indicated that OE items have been found in recent years, especially in the vicinity of the "1942" Camp Butner water tower located off Central Avenue (Figures 3.2a and 3.2b). The water tower is situated within proximity to the ASR-designated former flame thrower/small arms ranges, which may have served other training purposes. A discovery of a 2.36-inch HE rocket located adjacent to the Camp Butner water tower was made in 2000.

3.2.1.3 Approximately 5.3 acres geophysically mapped in Area 1 were intrusively investigated during the EE/CA investigation. This acreage represents approximately 0.2% of the 3,300 acres encompassed by Area 1. Due to widespread development within the Town of Butner including: residential housing, public schools, and state and federal facilities, placement of sampling grids in Area 1 was focused primarily in undeveloped areas.

3.2.1.4 Locations of the intrusively investigated grids are presented in Figures 3.2a and 3.2b. Based on the anomaly ranking criteria and selection strategy (described in Subchapter 3.1.4), a total of 315 (311 Rank 1, 2 Rank 2, and 2 Rank 3) anomalies were intrusively investigated. Results from the intrusive investigation identified two (0.6%)

UXO and 5 (1.5%) OE scrap items out of the 311 investigated in Area 1. Thirty-four (11%) of the anomalies investigated were considered "false positives" as no discernible metallic debris were found. The two UXO items were confined to a small training area near the water tower. Appendix C presents the intrusive findings of the UXO, OE scrap, and non-OE scrap/Other items found in Area 1.

3.2.1.5 The intrusive results from Area 1 show recovered UXO and OE scrap items concentrated in grids located northeast of the water tower off Central Avenue. The two UXO items recovered from the general area included an Mk II hand grenade and an M1 practice mine with spotting charge and fuze recovered at 1 inch and 10 inches below ground surface (bgs), respectively. Intrusive findings identified OE scrap consisting of five inert (expended) M15 grenades. The ordnance related intrusive findings and concrete fortification are indicative of a grenade training range at this location.

3.2.1.6 ***Area 1 has been found to contain UXO items and OE scrap items as identified during the EE/CA.*** The UXO and OE scrap findings of the EE/CA investigation were recovered from four of the six total grids within the vicinity of the water tower located off Central Avenue. Both UXO items recovered were Rank 1 anomaly selections. The remainder of intrusive findings, approximately 98% of the anomalies investigated, in Area 1 consisted of non-OE scrap and Other.

3.2.2 Area 2

3.2.2.1 Area 2 is identified as the Ammunition Storage Area and Dump located north of the Town of Butner along State Route 75/County Road 1104 (Figure 3.4). Area 2 was designated as an approximately 7 acre tract. The land is owned by the State of North Carolina and is currently idle. Several World War II vintage earth covered magazines remain; otherwise the parcel is partially forested with thick underbrush. Some magazines have been used by local farmers to store agricultural products.

3.2.2.2 The ASR recommended an EE/CA investigation of Area 2 based on the "potential" presence of UXO. Aside from the storage magazines remaining, no OE was discovered during the ASR reconnaissance and no records of OE findings since facility closure were found (USACE, 1997).

3.2.2.3 A total of approximately 5.8 acres were geophysically mapped during the EE/CA investigation of Area 2. This acreage represents approximately 83% of the 7 acres designated for this area. Sampling was not conducted atop the magazine locations. Figure 3.4 depicts the location of grids sampled in Area 2. Based on the anomaly ranking criteria and the approved anomaly selection strategy, 288 (235 Rank 1, 34 Rank 2, and 19 Rank 3) geophysical anomalies were selected for intrusive investigation.

3.2.2.4 During the intrusive investigation, the Project Geophysicist evaluated intrusive results for the presence of ordnance related findings. Based on the intrusive results, an assessment was made after 195 (77%) of the selected anomalies had been investigated. The results revealed that no UXO or OE scrap items had been recovered in

Area 2. Thirteen (7%) of the anomalies investigated were considered "false positives" as no discernible metallic debris was found. Because the distribution of sampling provided representative coverage (approximately 4.2 acres) in conjunction with the lack of presence of UXO or OE scrap in the sampled population, the decision was made by the project team, in accordance with the USAESCH PM, to discontinue further intrusive investigation of Area 2.

3.2.2.5 ***No UXO items were found in Area 2.*** Non-OE scrap recovered included items such as nails, wires, metal rods, barbed wire, pipes, steel strap, metal scrap, etc. Appendix C presents the intrusive investigation summary of non-OE scrap and Other items found in Area 2.

3.2.3 Area 3

3.2.3.1 Area 3 is identified as Grenade Training Ranges that were reportedly located within the current Umstead Farm (North Carolina Department of Agriculture and Consumer Services), a dairy cattle research farm (Figure 3.5). The approximately 5-acre parcel designated for the EE/CA investigation is located in open pasture located approximately 0.25 mile west of the intersection of County Road 1004 and County Road 1121.

3.2.3.2 The ASR recommended investigation of Area 3 based on the "potential" presence of UXO. No OE was discovered during the ASR reconnaissance and no records of OE findings since facility closure were found (USACE, 1997). The Umstead Farm Unit Superintendent was interviewed during the Site Visit (Parsons, 2000) and stated he was familiar with the history of the grenade range but was unaware of its exact location within the farm.

3.2.3.3 Approximately 8.5 acres were geophysically mapped in and around Area 3. A total of 1173 (743 Rank 1, 231 Rank 2, and 199 Rank 3) anomalies were selected for intrusive investigation based on the anomaly ranking criteria and the approved anomaly selection strategy. Concurrent to the intrusive investigation in Area 3, intrusive results were evaluated by the Project Geophysicist for the presence of ordnance related items. Following the excavation of 829 (71%) of the selected anomalies, a review of the intrusive results found no UXO or OE scrap items recovered from the approximately 6.4 acres investigated. Forty (5%) of the anomalies investigated were considered "false positives" as no discernible metallic debris were found. The project team, with USAESCH PM approval, concluded that no further characterization was warranted in Area 3 based on the lack of ordnance related findings.

3.2.3.4 ***No UXO items were found in Area 3.*** Non-OE scrap recovered included items such as horse shoes, plow blades, leaf springs, hinges, an ax head, nails, wires, metal scrap, etc. Appendix C presents information tabulated from dig sheets that summarizes and describes non-OE scrap/Other items found in Area 3.

3.2.4 Area 4

3.2.4.1 Area 4, the Ammunition Training Ranges and Impact Area, is the largest AOI, comprising the entire northern half and east-central portion of the site (Figure 3.6). Area 4 includes nearly 21,950 acres (greater than 34 square miles) of training ranges, impact areas, and buffer zones. The land is owned by private and state entities with a variety of land uses including agriculture and low density residential development. The areas not utilized for agricultural or residential purposes consist of moderate to heavy forest.

3.2.4.2 The ASR recommended further investigation of Area 4 based on the "confirmed" presence of UXO (USACE, 1997). This determination was based on direct witness of ordnance items, documented evidence verifying actual witness by others since closure, or statements from individuals with factual knowledge of ammunition presence/recovery. Two 155mm projectiles were observed at a homestead located off Enon Road in Area 4, during the ASR reconnaissance (USACE, 1997). The ASR team located the remains of a mock German village and movable ammunition targets, which was subsequently verified by Parsons' field teams. During the site visit, the Site Investigation (SI) team discovered a large fragment of a 105mm HE projectile located at a homestead within this sector. Based on the discoveries made by the ASR team, Area 4 was confirmed as having ordnance present.

3.2.4.3 During the course of the EE/CA investigation, ongoing field investigation activities generated public awareness, which triggered numerous calls from local residents. Parsons received several reports from local residents and authorities that pertained to past and present ordnance related findings throughout Area 4. For example, one property owner, residing along the eastern boundary of the site, informed Butner Public Safety and Parsons of findings uncovered while tilling one of his fields. The items were later identified as inert 2.36-inch practice rockets and were disposed of by Fort Bragg EOD. Another property owner, located in the northern central region of the site, reportedly discovered several fuzes and a 155mm HE projectile on his property and contacted Fort Bragg EOD for removal and disposal of the ordnance items. This same property owner also subsequently found a 105mm HE projectile. Another finding was reportedly made by an adjacent neighbor who described discovering a 155mm HE projectile on his property approximately ten years ago, which Fort Bragg EOD detonated. These reported findings prompted the placement of sampling grids on the above properties in the vicinity of the discovered items.

3.2.4.4 At a public meeting held in April 2002, a Lakeview Subdivision property owner informed USAESCH and Parsons of the recent discovery of a 2.36-inch rocket on his property in November 2001. As a result of the meeting, USAESCH instructed Parsons to place sampling grids (A4G1436 and A4G1437) on the property where the 2.36-inch rocket was found. A total of 82 anomalies were selected for investigation; all Rank 1, Rank 2, and Rank 3 anomalies were excavated. A 37mm projectile (UXO), an inert 60mm mortar tail boom, and various other OE scrap items were recovered during

the intrusive investigation. Based on the UXO finding from the EE/CA investigation, a TCRA was conducted at the Lakeview Subdivision (Parsons, 2003).

3.2.4.5 Due to the large size of Area 4, the implemented sampling strategy focused on sampling within known impact and suspect areas, while also achieving a broad distribution of sampling coverage (representative coverage). As discussed above, when local residents reported discovering ordnance items coincident to the ongoing field investigation, sampling grids were placed at the general location of the finding as approved by USAESCH. Representative coverage was attained mainly by using sampling grids, but also included small areas mapped by meandering path transects. In areas of very rugged terrain and steep inclines, "mag-and-dig" operations were performed (as described in Subchapter 3.1.3) to supplement the geophysical mapping. "Mag and Dig" surveys were also performed on newly assigned grids that were placed in areas of concern identified during the intrusive phase of the EE/CA investigation.

3.2.4.6 A total of approximately 77 acres were intrusively investigated in Area 4 during the EE/CA investigation. This acreage represents 0.4% of the 21,950 acres designated within Area 4. Based on the anomaly ranking criteria and the approved anomaly selection strategy, a total of 4968 anomalies were intrusively investigated. A total of 11 UXO (0.2%) and 1485 OE scrap items (30%) were recovered from the anomalies investigated in Area 4. The UXO items found included an M-series nose fuze, two 2.36-inch rockets, a 2.36-inch warhead, three 37mm projectiles, a 57mm projectile, two 105mm projectiles, and a 155mm shrapnel round. These items were recovered from depths ranging from ground surface to 30 inches bgs (Table 3.1). Two hundred and thirty (5%) of the anomalies investigated were characterized as "false positives" as no discernible metallic debris was found. Included in the total acreage investigated are "mag-and-dig" sampling grids totaling 19 grids with 570 anomalies excavated. Appendix C presents information tabulated from dig sheets that summarizes and describes UXO, OE scrap, and non-OE scrap/Other items found in Area 4.

3.2.4.7 An additional 26 acres were intrusively investigated as part of the TCRA at the Lakeview Subdivision. The "mag and dig" method was used during the 0 to 6 inch clearance, which consequently biased findings in this area to within 6 inches bgs. Six UXO were recovered including an electric blasting cap, a M1 A1 landmine fuze, a Mk II hand grenade, a 37mm HE projectile, and (2) 2.36-inch rocket warheads. A total of 66 OE scrap items were recovered including remnants of M1 landmine fuzes, 2.36-inch rocket motors and fins, 60mm fins, and rifle grenade tail booms.

3.2.4.8 ***Area 4 has been found to contain UXO items and OE scrap items as identified during the EE/CA and TCRA investigations.*** The spatial distribution of UXO and OE scrap findings in the north, west and central regions of Area 4 is generally consistent with known impact areas from former firing ranges. UXO items originally selected from digitally mapped data consisted of 9 Rank 1 and 1 Rank 2 selections. The remainder of the UXO items, (1) EE/CA and (6) TCRA, were recovered using the "mag and dig" operations.

3.2.5 Area 5

3.2.5.1 Area 5, referred to as Remaining Land, is the second largest AOI, comprising most of the southern third of the project site (Figure 3.7). Area 5 includes nearly 10,372 acres (16.2 square miles) of outlying land between the cantonment area and the artillery training ranges. The land included in Area 5 is currently owned by such entities as Federal Correctional Facilities, state owned cattle farms, Waterfowl Impoundment Reserve, as well as private property. The majority of the land is dedicated to agriculture and forestry.

3.2.5.2 The ASR recommended no action for Area 5. This determination was based on lack of confirmed or potential evidence of UXO. No OE was discovered during the ASR reconnaissance and no records of OE findings since facility closure were found (USACE, 1997).

3.2.5.3 Approximately 14.3 acres were intrusively investigated during the EE/CA investigation. This acreage represents approximately 0.1% of the 10,372 acres encompassed by Area 5. Geophysical survey techniques utilized in Area 5 primarily consisted of grid surveys, with some meandering path transects. Sampling coverage in Area 5 was broadly distributed. Based on the anomaly ranking criteria and the approved anomaly selection strategy, a total of 754 anomalies were intrusively investigated. A single "spider" plate (pressure plate) from an M1 anti-tank practice mine was recovered from grid A5G0018 located in a wooded area adjacent to a cultivated field and represented the only OE scrap item. Seventy-three (10%) of the anomalies investigated were considered "false positives" as no discernible metallic debris were found. No other ordnance related findings were discovered in Area 5.

3.2.5.4 ***No UXO items were found in Area 5.*** One OE scrap item was recovered from Area 5 during the EE/CA investigation. The item, an inert "spider" plate (pressure plate) from an M1 anti-tank practice mine, was found at ground surface. Appendix C presents information tabulated from dig sheets that summarizes and describes OE scrap and non-OE scrap/Other items found in Area 5.

3.3 RECOVERED ORDNANCE ITEMS

The OE-related items recovered during the EE/CA and TCRA investigations are presented in Table 3.1. Recovered OE scrap items included remnants from practice mines, various fuzing mechanisms, 2.36-inch bazooka rockets, 37mm projectiles, 57mm projectiles, 60mm mortars, 81mm mortars, 105mm projectiles, and 155mm projectiles. Appendix E provides a brief description of the UXO items recovered during the EE/CA intrusive investigation at the former Camp Butner.

3.4 FIRING FANS

3.4.1 Presently, the only archival evidence delineating the various firing ranges is the 1942 Target Range Locations Layout Map contained in the ASR. Firing fans are

known only to have been configured throughout Area 4 and Area 6 (currently the NCNG training site) and are presented in Figure 2.3. The layout map designated Range 10 as a proposed 37mm Anti-Tank Range. Range 11 was designated for 60mm and 81mm trench mortars and was placed to the north of Range 10. Ranges 10 and 11 were both established for firing west to east. Range 14 was also designated for 60mm and 81mm trench mortars but was oriented for firing south to north. The impact areas used by each of these three ranges fall within the same general location of the site.

3.4.2 Range 12 and Range 13 were located in the northern half of Area 4. Range 12 was configured to fire from north to south and was originally proposed for rifle and light machine gun training. Range 13 was originally proposed for the same purpose and configured to fire from east to west, consequently sharing the same impact area as Range 12. It is unlikely that either Range 12 or Range 13 were used for small arms based on impact craters and recovered ordnance (consists mostly of 105mm and 155mm projectiles) from the presumed impact area. Therefore, the most likely designation for both of these ranges would have been for the firing of 105mm and 155mm artillery. The dedudding map presented in the ASR depicting ordnance found during annual inspections between 1958 and 1967 confirmed that numerous HE ordnance including 37mm, 40mm, 81mm, 105mm, 155mm, 240mm, 2.36-inch rockets, and rifle grenades were discovered in and around the firing fans and impact area of Area 4. In addition, TEC's historical aerial photographic interpretation identified numerous impact craters within these firing ranges consistent with heavy artillery training (USACE, 2001a).

3.5 RE-SECTORIZATION OF AOI BOUNDARIES

As a result of the EE/CA site characterization, the original AOI boundaries have been modified in order to facilitate selection of OE response alternatives. The re-sectored AOI boundaries are based on UXO type, UXO distribution, and current and near future land use. Refinement of the area boundaries enhances distinction of the spatial distribution of UXO and ordnance related findings. In general, grids identified as containing UXO and OE scrap usually appear in clusters with findings of similar ordnance type. Areas 1 through 5 have undergone boundary modifications as described below. A breakdown of re-sectored AOIs with respective boundary revisions is presented in Table 3.2.

3.5.1 Area 1A

3.5.1.1 The boundary that now delineates Area 1A includes sampled grids characterized with UXO and OE scrap located just north and east of the water tower and is comprised of approximately 20 acres (Figure 3.8). Area 1A falls within the Flamethrower Range identified in the MMR Range Inventory (Subchapter 2.6.9). The EE/CA findings for this newly designated AOI included two UXO items (a M1 practice anti-tank landmine with spotting charge and fuze and a Mk II hand grenade) and five OE scrap items (all expended and inert M15 smoke grenades) from 98 anomalies investigated (Appendix C). The land is currently undeveloped, primarily wooded, with moderate soil erosion in drainage areas caused by storm runoff at the northeast portion of the AOI. The

Butner Long Range Master Plan proposes future land use in this area will be for recreational activities and include the passage of a greenway/trail system (O'Brien/Atkins, 1998). However, other uses are actively being considered to include a day care facility and adjacent development.

3.5.1.2 In addition to the UXO findings, several concrete fortifications (possibly used as grenade throwing bays) located a few hundred feet from the water tower have been identified in the ASR and verified by Parsons field teams. Other findings include a 2.36-inch bazooka rocket reportedly found in unknown condition by a private citizen near the water tower concurrent to this EE/CA investigation. Historically this area was designated as a flame thrower/small arms range; however, the findings from the EE/CA suggest that this area was also used as a grenade training range.

3.5.2 Area 4

3.5.2.1 Area 4 falls within both Range Complex 1 and Range Complex 2 identified in the MMR Range Inventory (Subchapter 2.6.9). Based on results from the intrusive investigation, clusters of sampled grids containing UXO or high density OE scrap emerged in various regions of the AOI (Appendix C). These localized regions within this area will be addressed independently. The advantage to partitioning Area 4 is that response alternatives can be tailored on the basis of site-specific findings that take into account local land use and type of UXO recovered. The proposed boundary modifications will delineate five additional areas (sub-sectors) within Area 4 according to these criteria. The remainder of land within the original boundary will still be defined as Area 4 and includes approximately 21,139 acres (Figure 3.9).

3.5.2.2 Although 5 UXO were recovered within the modified boundary of Area 4 (now 21,139 acres), all of the UXO and much of the OE scrap presence was concentrated in two areas: a generally undeveloped woodland area and an extensive hayfield area. In the woodland area, generally adjacent to the northern and eastern boundary of the NCNG training site (Area 6), three of the 5 UXO items were recovered. This portion of modified Area 4 encompasses the general location of impact areas associated with former Ranges 10 (37mm range) and 14 (60-81mm mortar range). The terrain consists mostly of forest with moderate to steep topography characterized by predominantly undeveloped woodlands well suited for the seasonal hunting activities that occur. Access is limited in this area due to adverse terrain and a small number of unpaved access roads. Only a few homesteads exist with future significant residential development is unlikely. UXO items identified included a 57mm HE projectile, a M-series fuze, and a low-order 105mm HE projectile (Table 3.3). OE scrap recovered from this same area included a total of 613 items consisting of HE projectile fragments from 37mm, 57mm, 75mm, 105mm, and 155mm projectiles. All items were recovered from less than 24 inches bgs with the majority recovered within 6 inches of the surface.

3.5.2.3 The second area (mostly comprised of hayfields operated by a single owner) generally encircles the area from north of the intersection of Moriah Road and

Uzzle Road and southward approximately 10,000 feet and enveloping open areas to the east and west of Uzzle Road (Figure 3.9). This area lies within the general location of impact areas associated with former Ranges 12 and 13 (both former heavy artillery ranges). UXO items recovered from this area included a 155mm shrapnel projectile and an unfuzed 2.36-inch HE bazooka rocket warhead (Table 3.3). OE scrap consisted primarily of 217 HE projectile fragments recovered from less than 24 inches bgs with the majority recovered within 6 inches of the surface.

3.5.2.4 A total of 288 OE scrap items were distributed throughout the balance of Area 4 (in addition to those mentioned above). No additional UXO was discovered. Land use is primarily dedicated to agriculture and forestry, with low to moderate density residential development distributed along the primary roads.

3.5.3 Area 4A

3.5.3.1 Area 4A encompasses the tract of land approximately 34 acres, bordered to the east by East Range Road (Figure 3.10). The single UXO item recovered from the intrusive investigation was a 2.36-inch HE bazooka rocket from a total of 150 anomalies investigated (Table 3.3). Sixteen out of the twenty OE scrap items recovered were remnants of 2.36-inch rockets, with one OE scrap item identified as a M9 rifle grenade fragment. All ordnance related items were recovered within 0 to 6 inches bgs. Parsons observed land features resembling fox holes in the northern area of the AOI indicative of a former military training site. These features were included within the EE/CA sampling coverage.

3.5.3.2 Area 4A lies within the general location associated with former bazooka and rifle grenade training ranges. Evaluation of historic aerial photographs indicated the presence of ground scars in this area of the site (USACE, 2001a). Further, the regular presence of UXO, particularly 2.36-inch bazooka rockets and 81mm mortars, during post-closure dedudding inspections confirm “live-fire” military training in Area 4A (within an area designated as Area B in historical records), as described in Subchapter 2.3.

3.5.3.3 The terrain in Area 4A consists mostly of forest with level to moderate slope topography. Recent findings included inert 2.36-inch rockets discovered by a property owner within the AOI. The property has recently been parceled in anticipation of residential development. As of July 3, 2003 some land clearing has been initiated, utilities are actively being sited, and residential lots are currently for sale and/or have been sold.

3.5.4 Area 4B

3.5.4.1 Area 4B encompasses the tract of land approximately 20 acres, bordered to the east by East Range Road. (Figure 3.10). The only UXO item recovered from the intrusive investigation of this area was a 2.36-inch HE bazooka rocket (Table 3.3). All four OE scrap items recovered from this area were identified as unidentifiable HE

fragments, possibly from 2.36-inch rockets. Site characterization was initiated at this location following a recent recovery of 2.36-inch inert bazooka rocket and related OE scrap by the property owner (paragraph 3.2.4.3). All OE scrap items were recovered within 0 to 6 inches bgs, although the single UXO item was encountered at 18 inches bgs.

3.5.4.2 Area 4B lies within the general location associated with former bazooka and rifle grenade training ranges. Evaluation of historic aerial photographs indicated the presence of ground scars and impact craters in this area of the site (USACE, 2001a). Further, the occasional presence of UXO, particularly 2.36-inch bazooka rockets, during post-closure dedudding inspections confirm "live-fire" military training in Area 4B (within an area designated as Area E in historical records), as described in Subchapter 2.3.

3.5.4.3 Land use in this area is light residential and dedicated for primarily farming purposes.

3.5.5 Area 4C

3.5.5.1 Area 4C encompasses the tract of land approximately 126 acres intersected by the power line easement and Uzzle Road (Figure 3.11). One UXO item was recovered during the intrusive investigation, which was identified as a 105mm low order HE projectile (Table 3.3). OE scrap recovered from grids centrally located to the UXO predominantly consisted of HE projectile fragments ranging in depth from 1 to 30 inches bgs.

3.5.5.2 Area 4E lies within the general location of impact area associated with former Range 12. The ASR lay out map designated Range 12 for heavy artillery such as 105mm to 240mm. Evaluation of historic aerial photographs indicated the presence of substantial impact craters in this area of the site (USACE, 2001a). Further, the regular presence of UXO (ranging from 37mm to 240mm and 2.36-inch bazooka rockets) during post-closure dedudding inspections confirm "live-fire" military artillery training in Area 4C (entirely within an area designated as Area A in historical records), as described in Subchapter 2.3.

3.5.5.3 Historic reports and present day site reconnaissance have identified the structural remnants of a target area known as the mock German village. Northern and southern target structures have been visually identified and are included within the AOI boundaries. Recent discoveries of 105mm and 155mm projectiles have been made by a property owner in the southern area of the AOI (paragraph 3.2.4.3).

3.5.5.4 Land use in Area 4C varies and is divided at the power line easement intersection: the northern portion is undeveloped woodland privately owned; and the southern portion consists of low density residential development.

3.5.6 Area 4D

3.5.6.1 Area 4D encompasses an area of land approximately 453 acres to the east of Isham Chambers Road (Figure 3.12). In Area 4D, the only UXO item identified was a 37mm projectile recovered at a depth of 2 inches bgs (Table 3.3). A total of 27 OE scrap items were identified as remnants from 37mm and 57mm projectiles, as well as HE projectile fragments. All were located at depths less than 10 inches bgs.

3.5.6.2 The ASR identified the general location as an impact area for Range 10 and Range 11, which were designated as a 37mm and 60mm/81mm mortar firing ranges, respectively. Evaluation of historic aerial photographs indicated the presence of minimal impact craters in this area of the site within the former Range 11 firing fan (USACE, 2001a). This AOI is not within an area that was included in post-closure dedudding inspections.

3.5.6.3 The area is mostly undeveloped consisting of forest with dense understory and rugged terrain. Signs of past and present logging activities (e.g. spoils and pine groves) have been observed at the southern portion of the AOI.

3.5.7 Area 4E

3.5.7.1 Area 4E is a parcel of land approximately 152 acres bordered by Isham Chambers Road to the north and east, and forest to the west and south (Figure 3.12). The single UXO item recovered during the intrusive investigation was a 37mm HE projectile (Table 3.3). The OE scrap item found in this area was a single piece of suspected HE projectile fragment recovered from 1 inch bgs.

3.5.7.2 Area 4E lies within the general location of impact areas associated with former Range 10. The ASR lay out map designated Range 10 for 37mm training. Evaluation of historic aerial photographs indicated the presence of impact craters and ground scars in this area of the site (USACE, 2001a). Further, the occasional presence of UXO (ranging from 37mm to 40mm and 2.36-inch bazooka rockets) during post-closure dedudding inspections confirm “live-fire” military artillery training in Area 4E (entirely within an area designated as Area D in historical records), as described in Subchapter 2.3.

3.5.7.3 A local farmer has reportedly uncovered 37mm OE items in the process of tilling the fields encompassed by this AOI over the years. Land use in Area 4E is almost exclusively dedicated to the cultivation of tobacco.

3.5.8 Area 5

3.5.8.1 The initial boundary assignment for Area 5 enveloped, but did not include Area 1, Area 2, or Area 3 within its confines. Intrusive efforts in Area 5 identified a single OE scrap item (“spider” plate to an M1 anti-tank mine) recovered from ground surface near a crop field. Other results from the intrusive investigations of Area 1 (excluding water tower findings), Area 2, and Area 3 indicate a lack of UXO/OE presence.

3.5.8.2 Due to the consistent lack of UXO/OE findings within each of these areas, the boundaries previously defining Area 1, Area 2, and Area 3 have been disbanded and these areas are now melded within the modified Area 5, which now totals 13,672 acres (Figure 3.13). Land use in this AOI includes agriculture, institutional, recreational, and residential. A comprehensive summary of intrusive results within the modified boundary of Area 5 shows 2,028 out of 2,029 anomalies investigated were identified as non-OE scrap and other findings.

3.5.9 Lakeview Subdivision

3.5.9.1 The Lakeview Subdivision (previously included in Area 4) is defined as a unique AOI due to regional findings and the establishment of boundaries occurring from the recently conducted TCRA. The Lakeview Subdivision Site encompasses approximately 26 acres including 16 acres that comprise the subdivision, and 10 acres of buffer zone extending around the entire site (Figure 3.14). Placement of sampling grids at this site during the EE/CA investigation was in response to a reported 2.36-inch rocket finding made by a local property owner (paragraph 3.2.4.4).

3.5.9.2 Findings made during the EE/CA investigation included one UXO (37mm projectile) and various OE scrap items, including 60mm mortar fins, were recovered at depths of less than 3 inches bgs. Subsequent to the EE/CA investigation, a TCRA was conducted at the site in which six UXO items (including an electric blasting cap, a Mk II hand grenade, a 37mm HE projectile, a M1 A1 landmine fuze, a 2.36-inch bazooka rocket, and a 2.36-inch bazooka rocket warhead) were recovered from within six inches of the ground surface (Table 3.3). A total of 80 OE scrap items were recovered from within six inches of the ground surface. Review of historic aerial photographs by TEC and the ASR findings did not indicate past training activities occurred at the site location.

TABLE 3.2
BREAKDOWN OF RE-SECTORED AOIs

RE-SECTORED AOI	TOTAL ACREAGE	BOUNDARY REVISIONS
Area 1A	20	Independent sub-sector previously part of Area 1
Area 4	21,139	Perimeter boundary remains the same; however independent sub-sectors formed within perimeter
Area 4A	34	Independent sub-sector previously part of Area 4
Area 4B	20	Independent sub-sector previously part of Area 4
Area 4C	126	Independent sub-sector previously part of Area 4
Area 4D	453	Independent sub-sector previously part of Area 4
Area 4E	152	Independent sub-sector previously part of Area 4
Area 5	13,672	Perimeter boundary remains the same; however Area 1, Area 2, and Area 3 are now dissolved within the perimeter
Lakeview Subdivision	26	Independent sub-sector previously part of Area 4

TABLE 3.3
SUMMARY OF RECOVERED UXO AND OE SCRAP BY AOI

AOI	UXO/OE Recovered	Depth (inches)	OE Scrap /Description
Area 1A	M1 anti-tank mine with spotting charge and fuze	10	**5 Items:** All expended/Inert M15 Smoke Grenades
	Mk II hand grenade	1	
Area 4	105mm HE fuzed	Surface	**1118 Items:** 37mm, 57mm, 75mm, 105mm, and 155mm HE projectile fragments
	57mm HE fuzed	6	
	Nose fuze M52 series (likely to a 60mm or 81mm)	3	
	2.36-inch HE bazooka warhead unfuzed	10	
	155mm shrapnel round unfuzed w/ expelling charge	30	
Area 4A	2.36-inch bazooka HE rocket	3	**20 Items:** 2.36-inch rocket debris, M9 rifle grenade fragment
Area 4B	2.36-inch bazooka HE rocket	18	**4 Items:** Unidentifiable HE fragments
Area 4C	105mm HE unfuzed	3	**313 Items:** 81mm, 105mm, and 155mm HE projectile fragments and fuzes

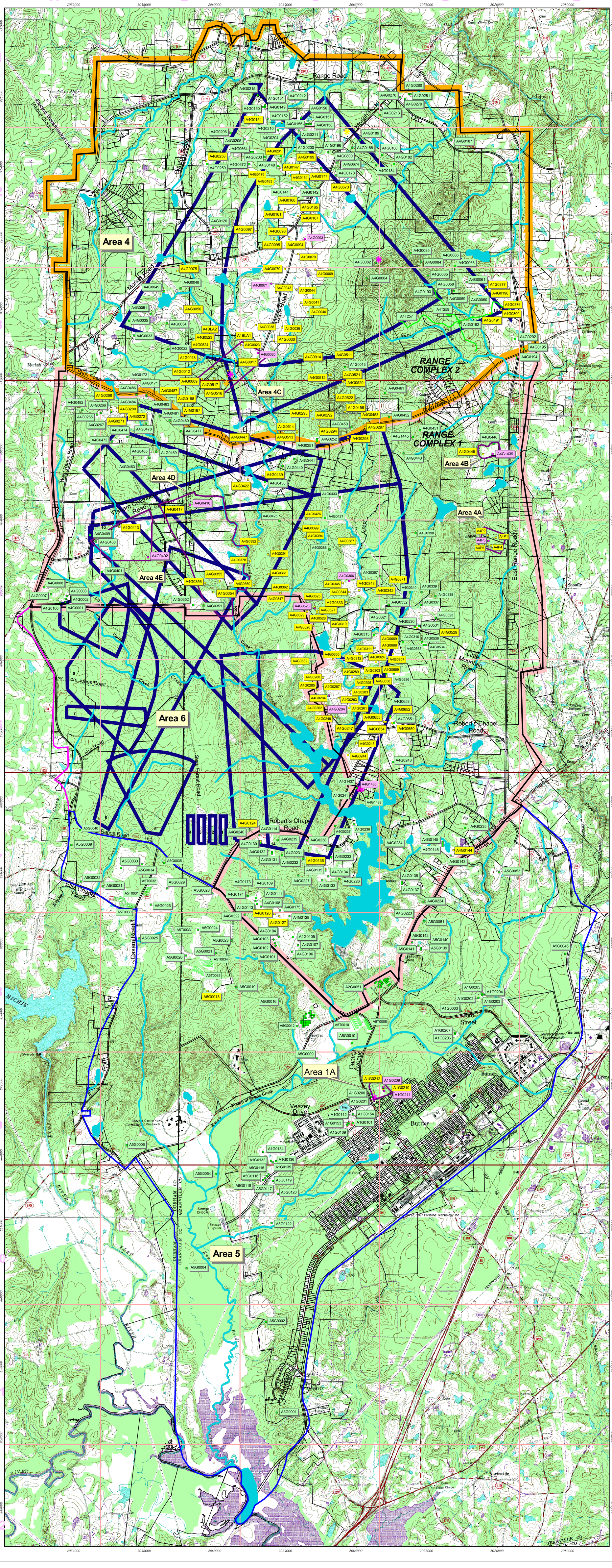
TABLE 3.3 (CONTINUED)
SUMMARY OF RECOVERED UXO AND OE SCRAP BY AOI

AOI	UXO/OE Recovered	Depth (inches)	OE Scrap /Description
Area 4D	37mm HE fuzed	2	**27 Items:** 37mm and 57mm fragments
Area 4E	37mm HE fuzed	1	**1 Item:** Unidentifiable HE projectile fragment
Lakeview Subdivision–EE/CA	37mm HE projectile	3	**1 Item:** 60mm mortar fins
Lakeview Subdivision – TCRA	Electric blasting cap	2	**80 Items:** Landmine parts, 2.36-inch rocket debris, mortar fins
	Mk II hand grenade	4	
	37mm HE projectile	2	
	M1 A1 Mine fuze	6	
	2.36-inch bazooka rocket motor w/fuze	1	
	2.36-inch HE bazooka warhead unfuzed	1	

Figure 3.1
EM-61 Digital Mapping Equipment in Operation

Photograph #1 – EM61/GPS Geophysical Survey in Progress – Single Cart EM61 Manual Configuration.

Photograph #2 – EM61 on Prove-Out Grid During Media Day.


Area 4
Area 4C
Area 4D
Area 4E
Area 4B
Area 4A
Area 6
Area 1A
Area 5
RANGE COMPLEX 2
RANGE COMPLEX 1
Range Road
Morgan Road
Butner
Veazey Drive
Central Avenue
Third Street
Robert's Chapel Road
Steam Chapel Road
East Range Road
Little Mountain Road
Sam Jones Road
Hill Road
Casem Road
Ellis Chapel Road
Bridge of Roots Creek
MICHIE RIVER
Creek
Branch
Lake
Dam
Cemetery
Sewage Disposal
Northside
Bridge
Cell Tower
Water Tower
Tank
Ranging Station
Cabin
Cemetery

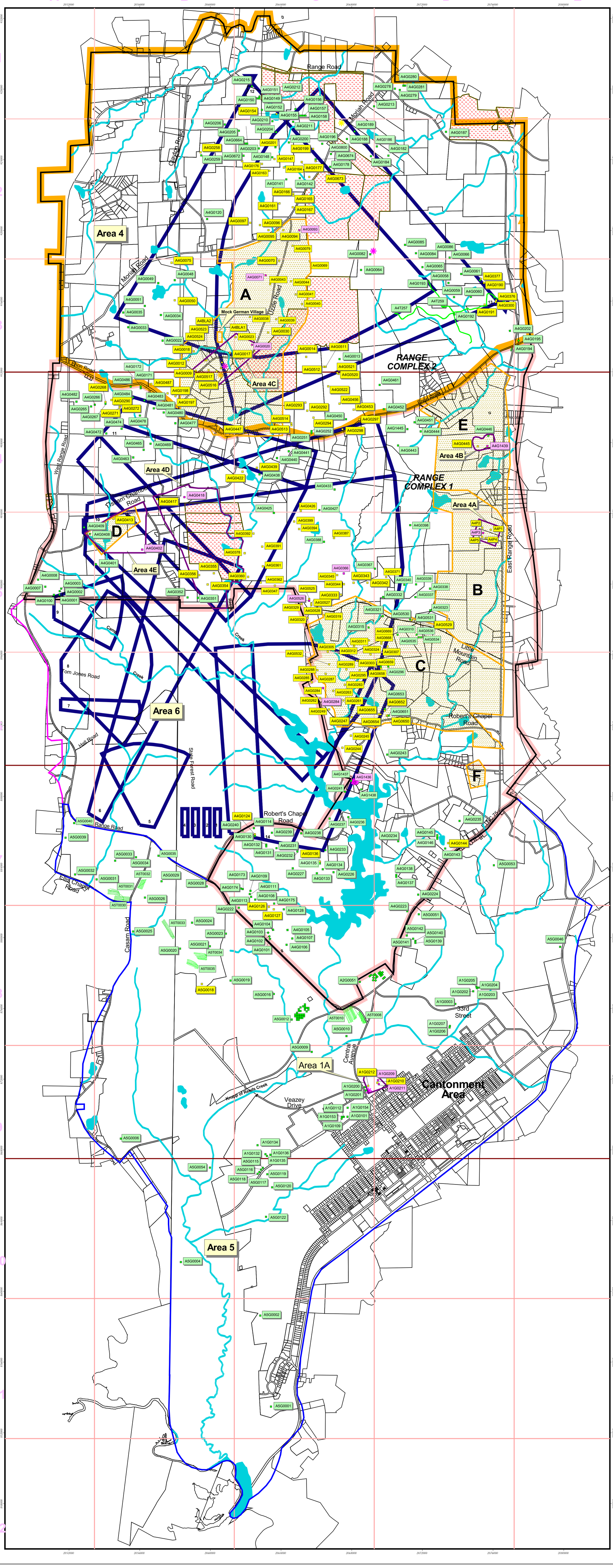
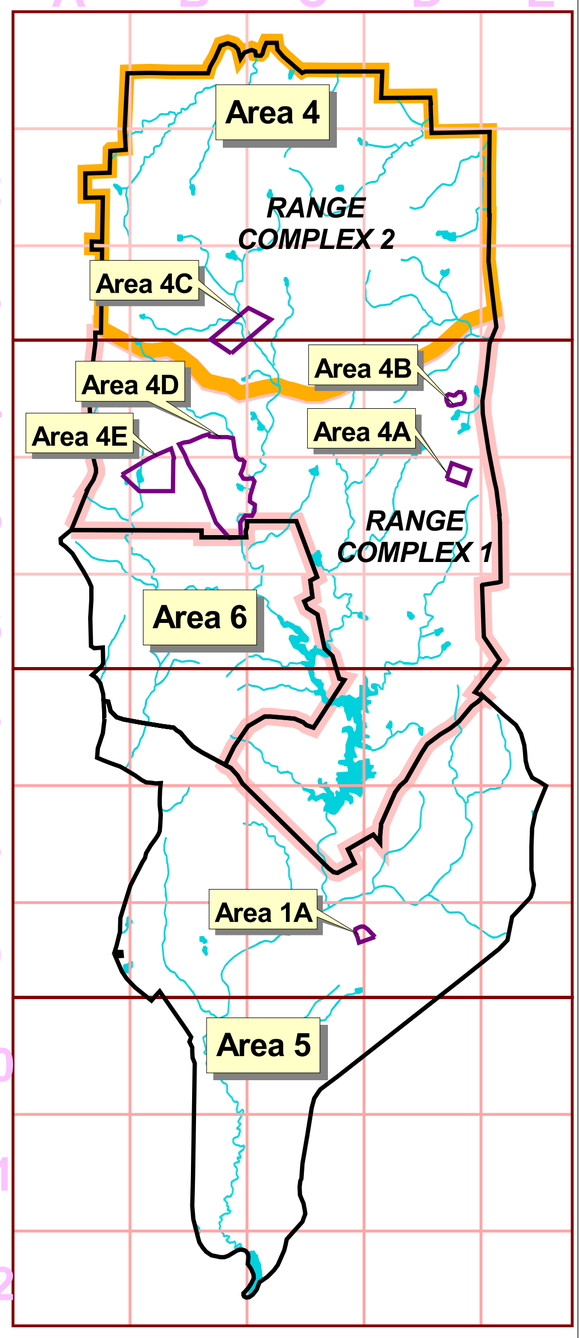


Figure 3.2b

Intrusively Investigated Grid Locations

Former Camp Butner
Butner, NC

Index Map



Legend

- Firing Fan
- Range Complex 1
- Range Complex 2
- Property Deed Restricted Prior to Government Release as "Surface Use Only" (Areas A - F) Due to Extensive Ordnance Presence (See Subchapter 2.3)
- Right of Entry Refused

Resectored Areas of Interest

- Areas 4A through 4E and 1A
- Area 4
- Area 5
- Area 6
- Parcel Boundary

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- Waterbody (SDTS Data, Buffered 50 Feet)
- Completed Transect (Intrusively Investigated - No OES)
- Recent Non-EE/CA UXO Findings
- Recent Non-EE/CA OES Findings
- UXO Findings 10 Years Ago

List of Ranges:

1 - 9 Small Arms
10 37 mm
11, 14 Trench Mortar, 60 mm and 81 mm
12, 13 Heavy Artillery

Map Units: NAD 1983 North Carolina State Plane (Feet)

2000 0 2000 4000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Intrusively Investigated Grid Locations	
DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 2,000 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-31
	FILE: x:\gis\738001\av_project\investigated_grid.apr	

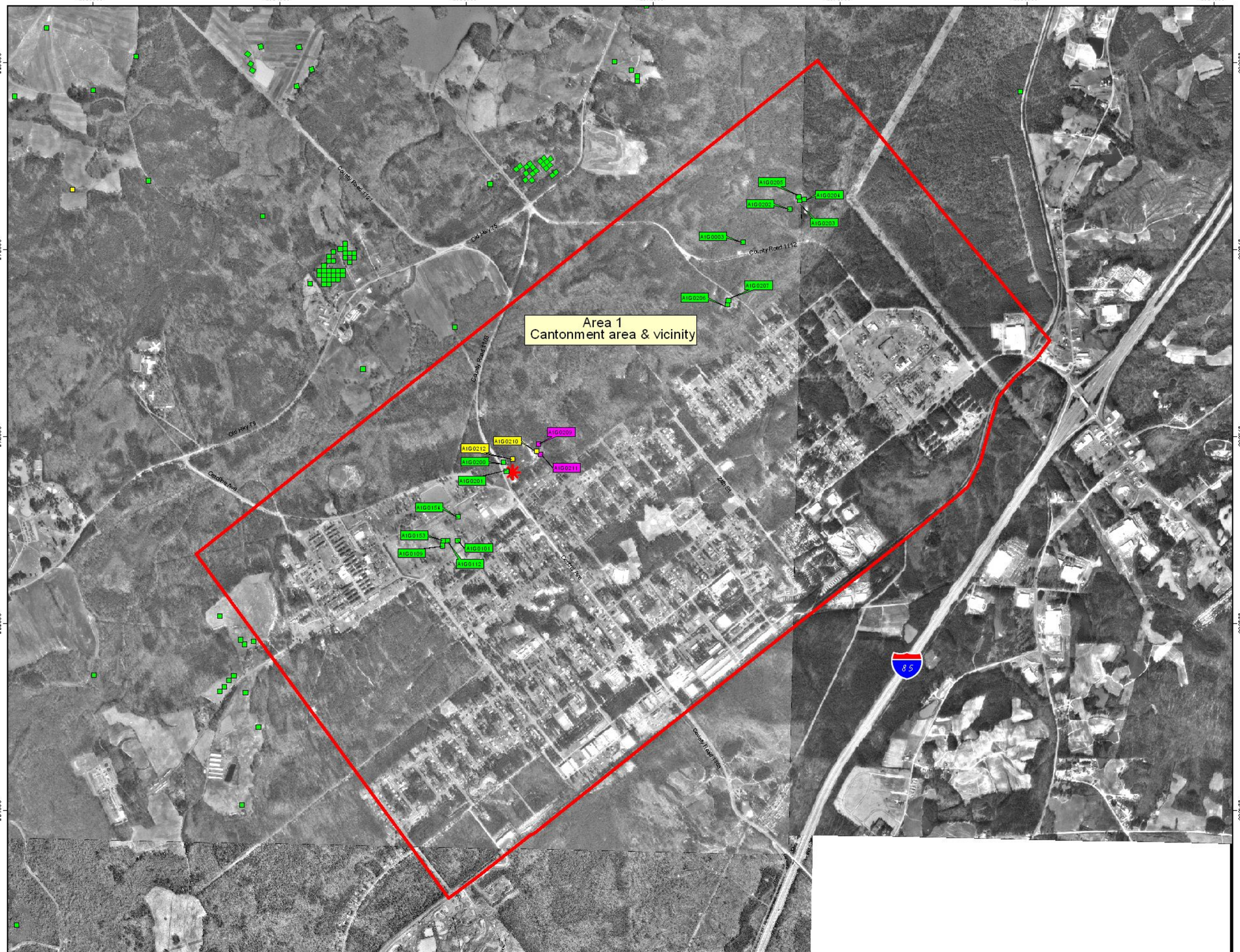
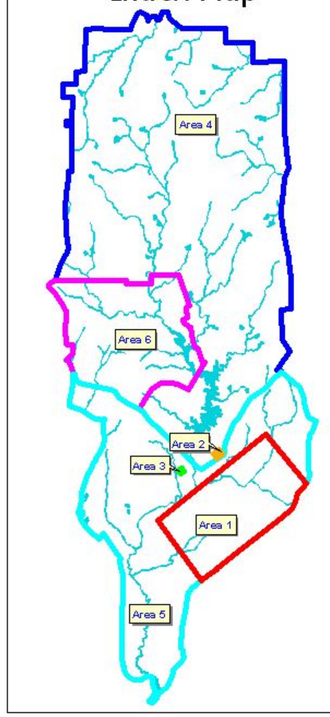


Figure 3.3

Completed Grids in Original Area 1

Former Camp Butner
Butner, NC

Index Map



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- Recent Non-EE/CA UXO Findings

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

2000 0 2000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

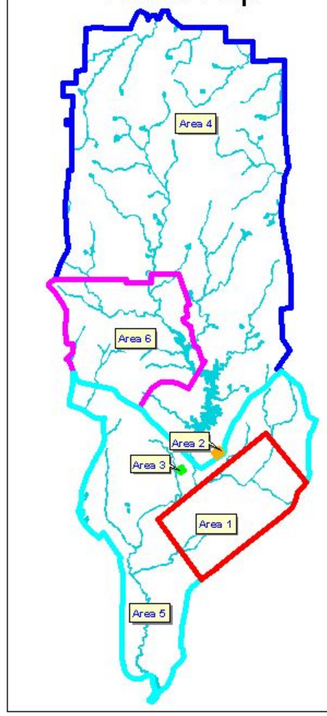
DESIGNED BY: BT	Completed Grids in Original Area 1	
DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 2,000 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-32
	FILE: x:\gis\738001\av_project\EECA.apr	

Figure 3.4

Completed Grids in Original Area 2

Former Camp Butner
Butner, NC

Index Map



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

500 0 500 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

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DRAWN BY: BT			
CHECKED BY: JK	SCALE: 1 inch equals 500 feet	PROJECT NUMBER: 738001	
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-33	
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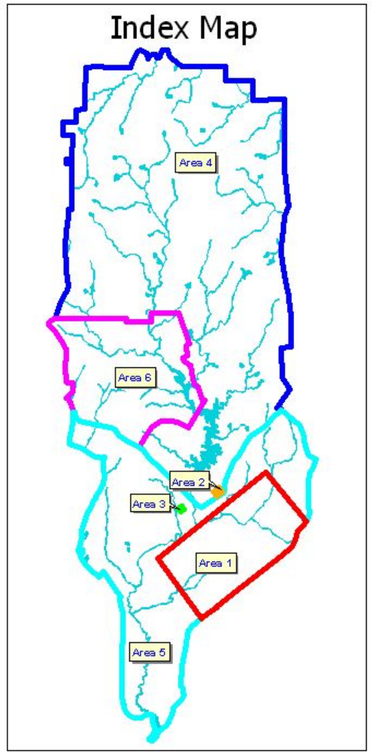
Figure 3.5

Completed Grids in Original Area 3

Former Camp Butner
Butner, NC



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

200 0 200 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Completed Grids in Original Area 3	
DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 200 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-34
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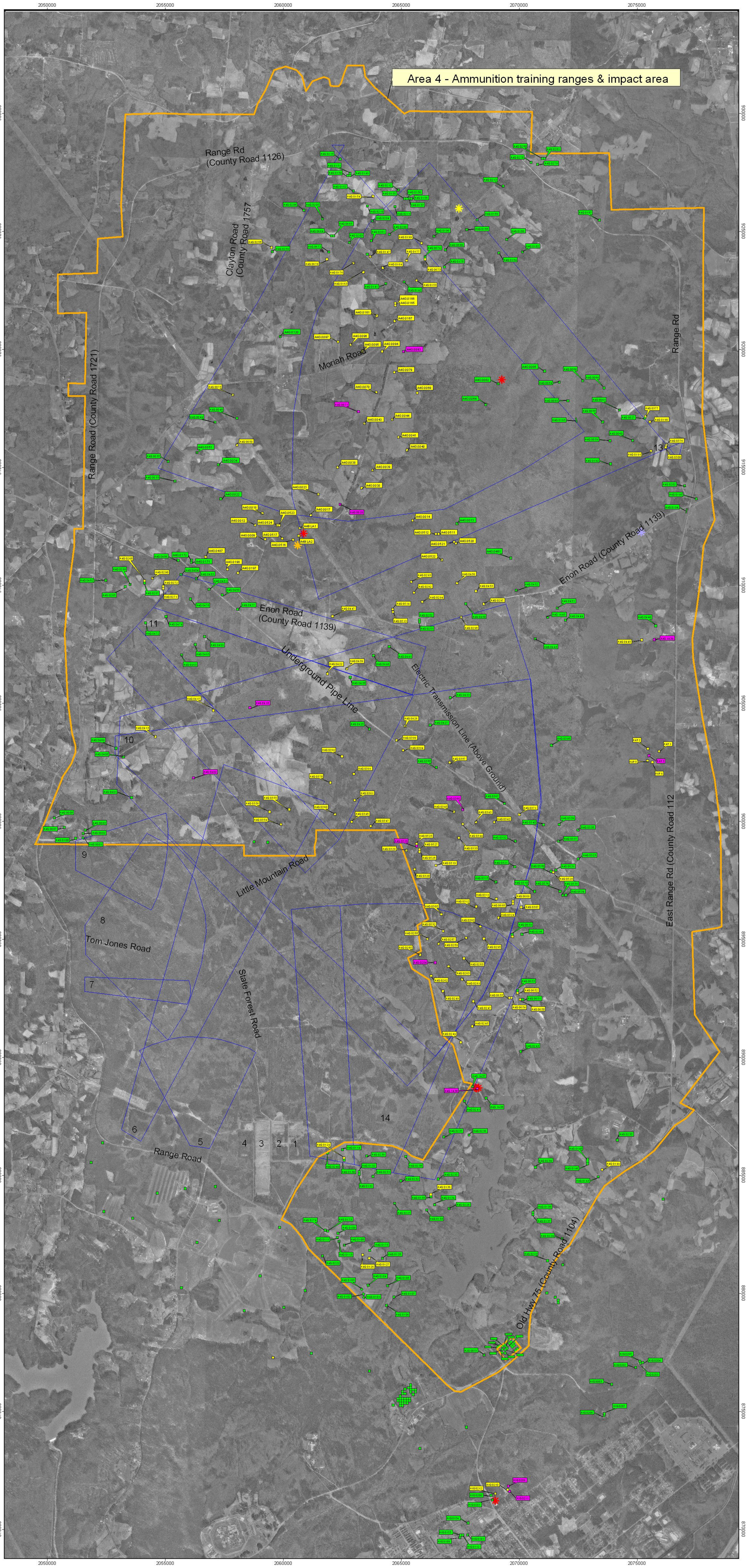
Figure 3.6

Completed Grids in Original Area 4

Former Camp Butner
Butner, NC



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- Historic Designated Range
- Recent Non-EE/CA UXO Findings
- Recent Non-EE/CA OES Findings
- Possible Well Disposal Site
- UXO Findings 10 Years Ago

List of Ranges:

1-9	Small Arms
10	37 mm
11, 14	Trench Mortar, 60 and 81 mm
12, 13	Heavy Artillery

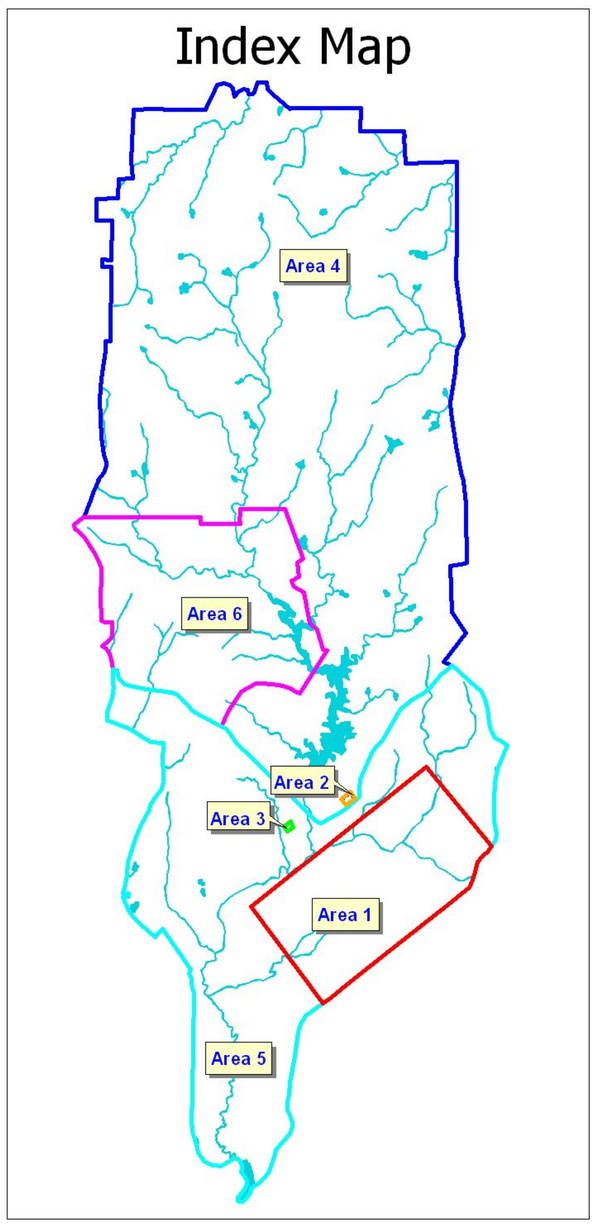


Image Source: 1993 Aerial Photo from TEC

Map Units: NAD 1983 North Carolina State Plane (Feet)

2000 0 2000 4000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Completed Grids in Original Area 4	
DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 2,000 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-35
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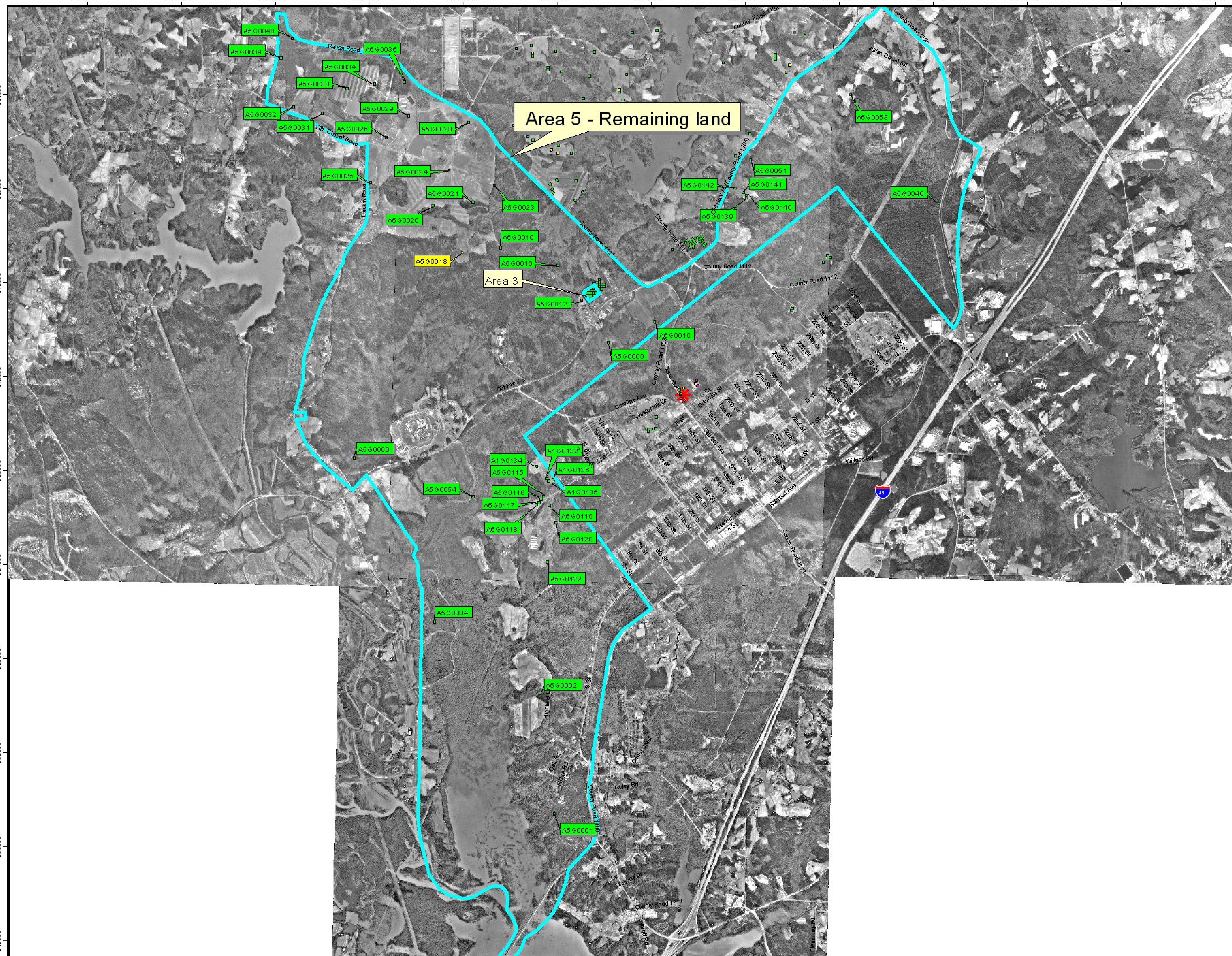
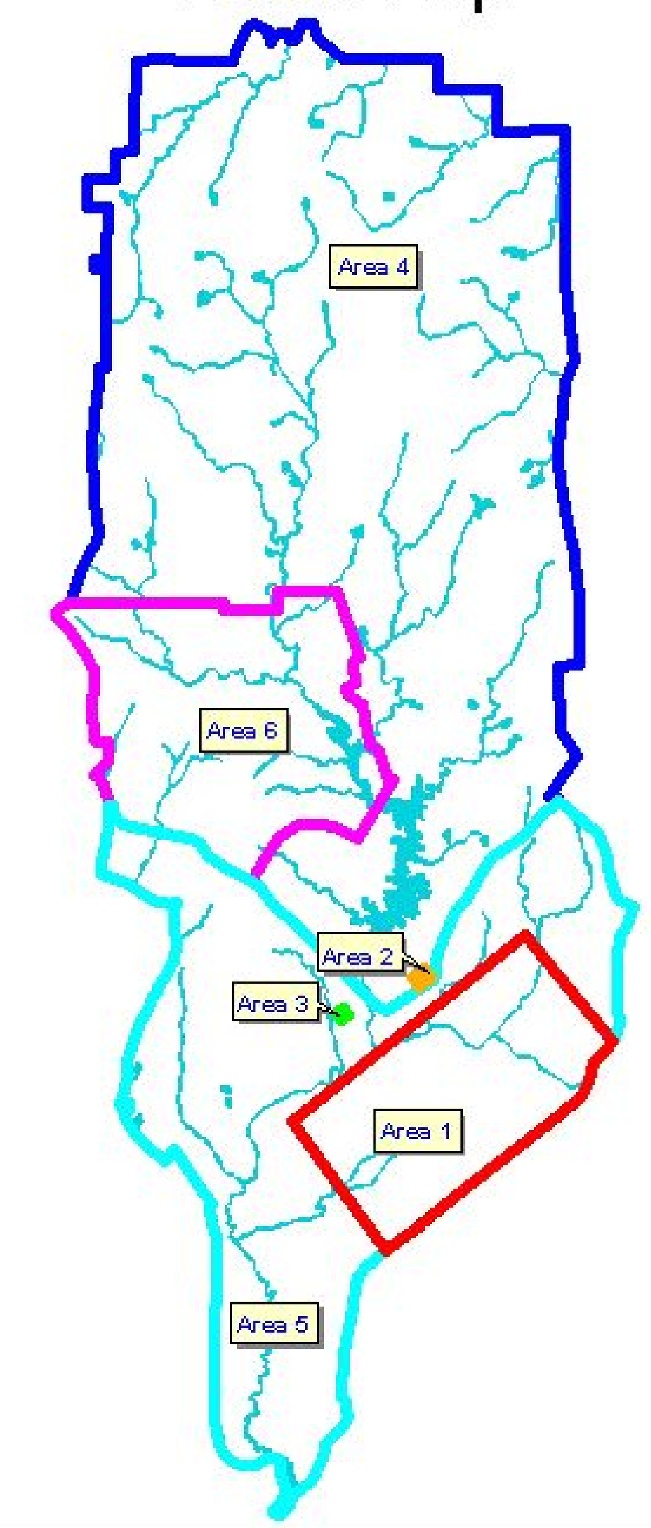
Figure 3.7

Completed Grids in Original Area 5

Former Camp Butner
Butner, NC



Index Map



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- * Recent Non-EE/CA UXO Findings

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

4000 0 4000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

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DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 4,000 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-36
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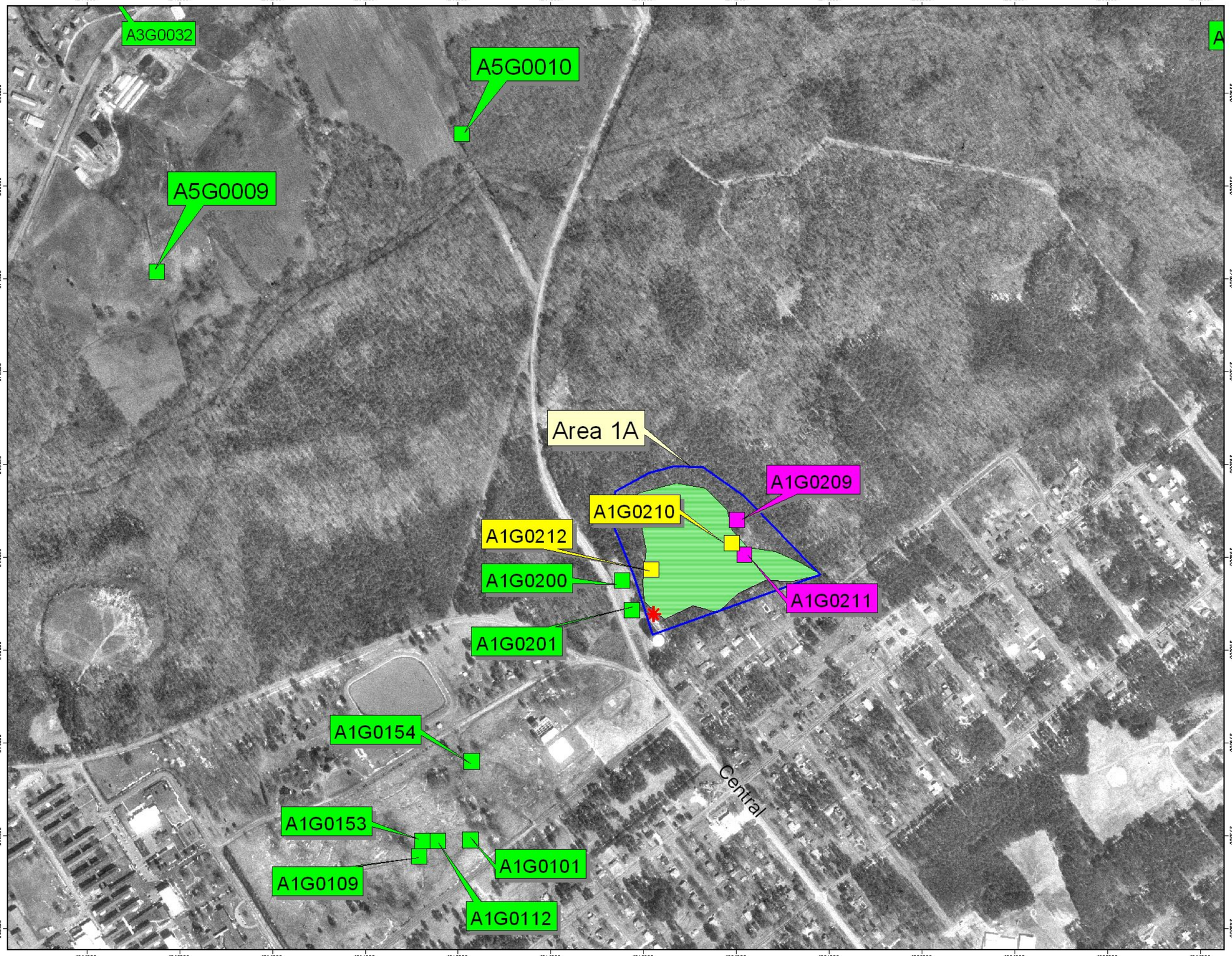
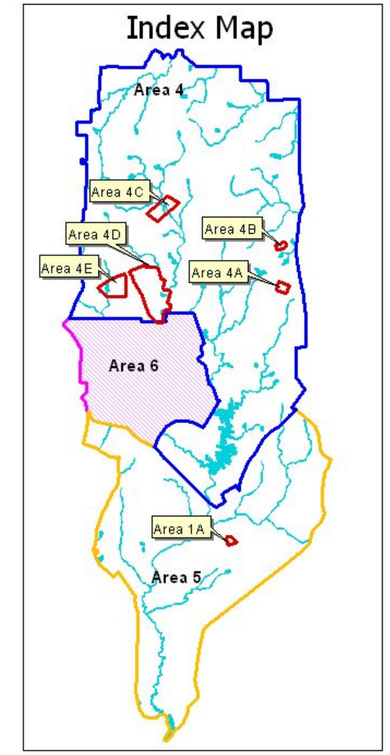


Figure 3.8

Completed Grids in Resectored Area 1A

Former Camp Butner
Butner, NC



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present

Aerial Photo Interpretation - USACE TEC, 2001

- Ground Scar
- Recent Non-EE/CA UXO Findings

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

600 0 600 Feet

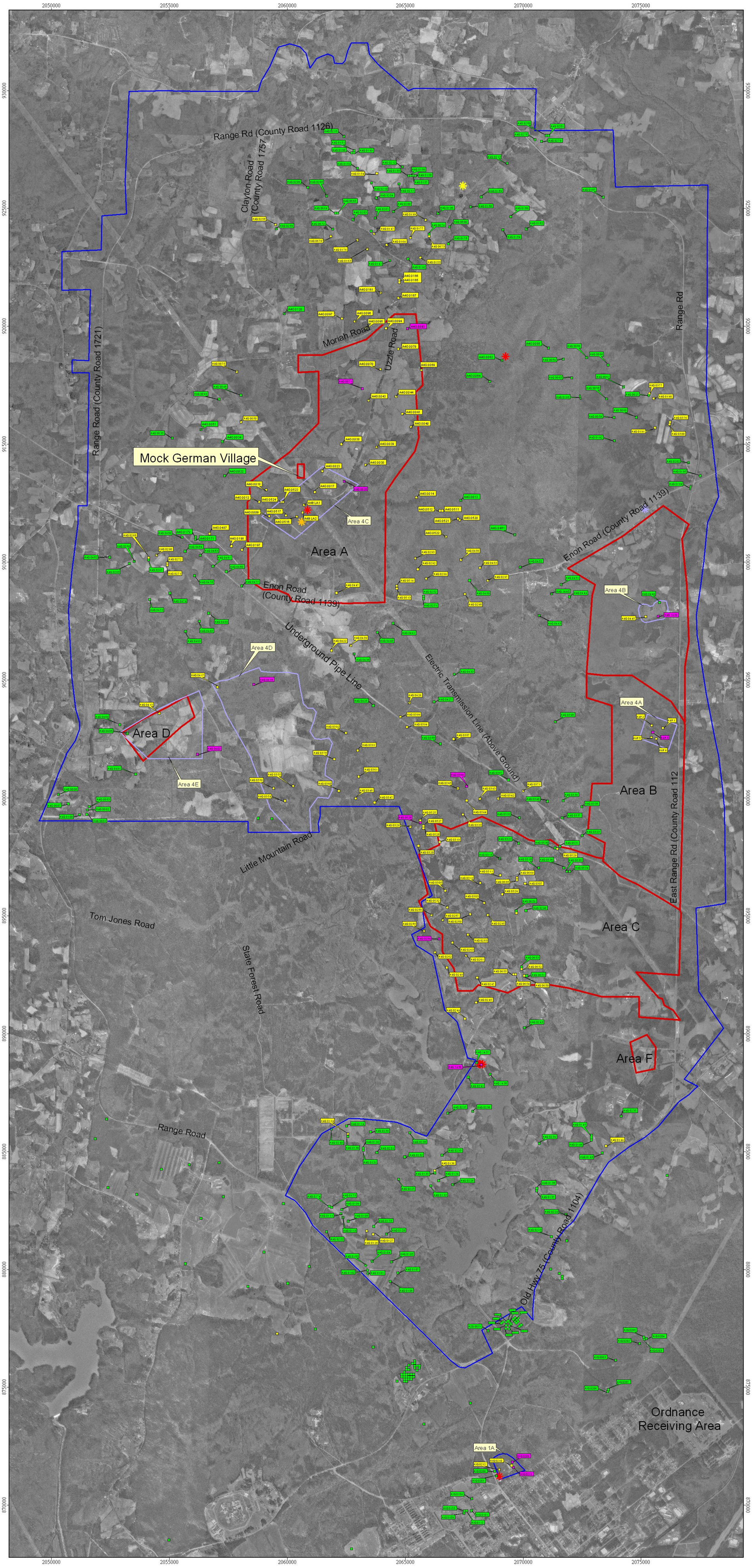
N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER
DESIGNED BY: BT	Completed Grids in Resectored Area 1A
DRAWN BY: BT	
CHECKED BY: JK	SCALE: 1 inch equals 600 feet / PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004 / PAGE: 3-37
	FILE: x:\gis\738001\av_project\EECA.apr

Figure 3.9

Completed Grids in Resectored Area 4

Former Camp Butner
Butner, NC



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- Property Deed Restricted Prior to Government Release as "Surface Use Only" (Areas A-F) Due to Extensive Ordnance Presence (See Subchapter 2.3)
- Recent Non-EE/CA UXO Findings
- Recent Non-EE/CA OES Findings
- Possible Well Disposal Site
- UXO Findings 10 Years Ago

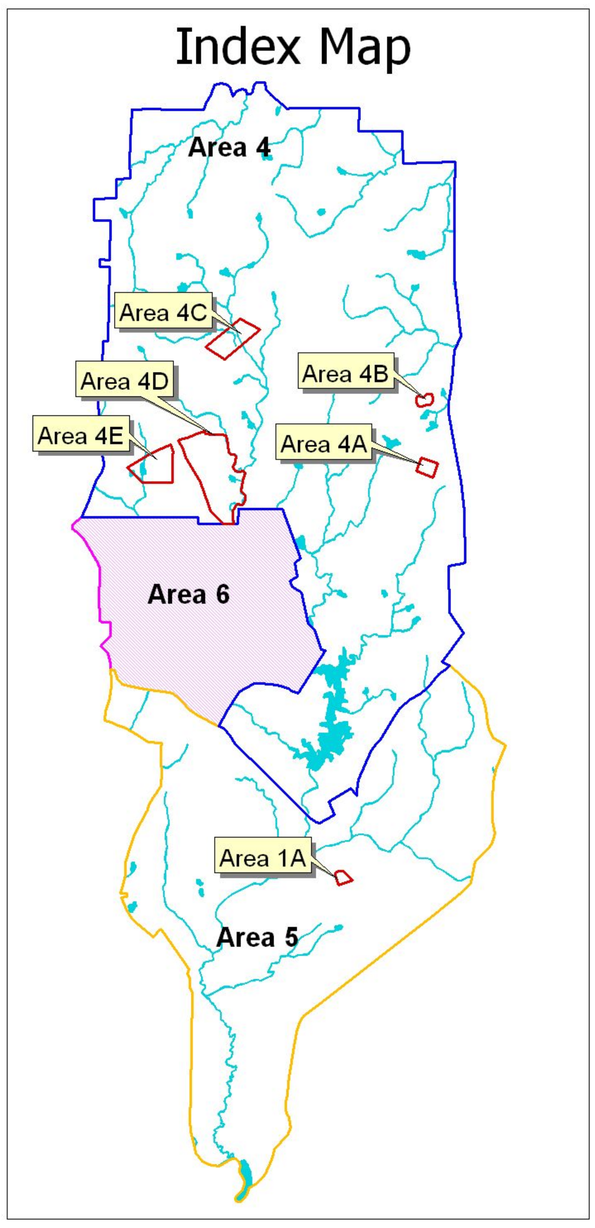


Image Source: 1993 Aerial Photo from TEC

Map Units: NAD 1983 North Carolina State Plane (Feet)

2000 0 2000 4000 Feet

N

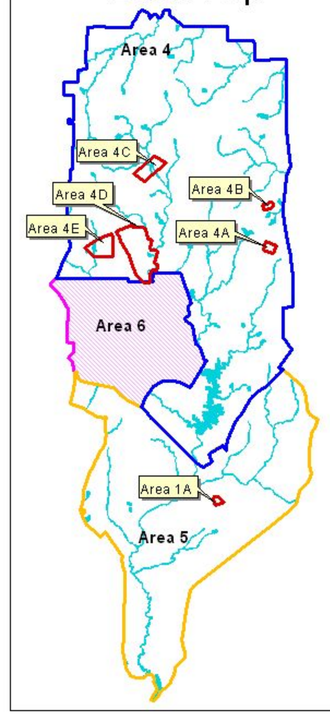
PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER
DESIGNED BY: BT	Completed Grids in Resectored Area 4
DRAWN BY: BT	
CHECKED BY: JK	SCALE: 1 inch equals 2,000 feet — PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004 — PAGE: 3-38
	FILE: x:\gis\738001\av_project\EECA.apr

Figure 3.10

Completed Grids in
Resectored Area 4A&4B

Former Camp Butner
Butner, NC

Index Map



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present

Aerial Photo Interpretation - USACE TEC, 2001

- Ground Scar
- Impact Crater
- Recent Non-EE/CA UXO Findings

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

1000 0 1000 Feet

N

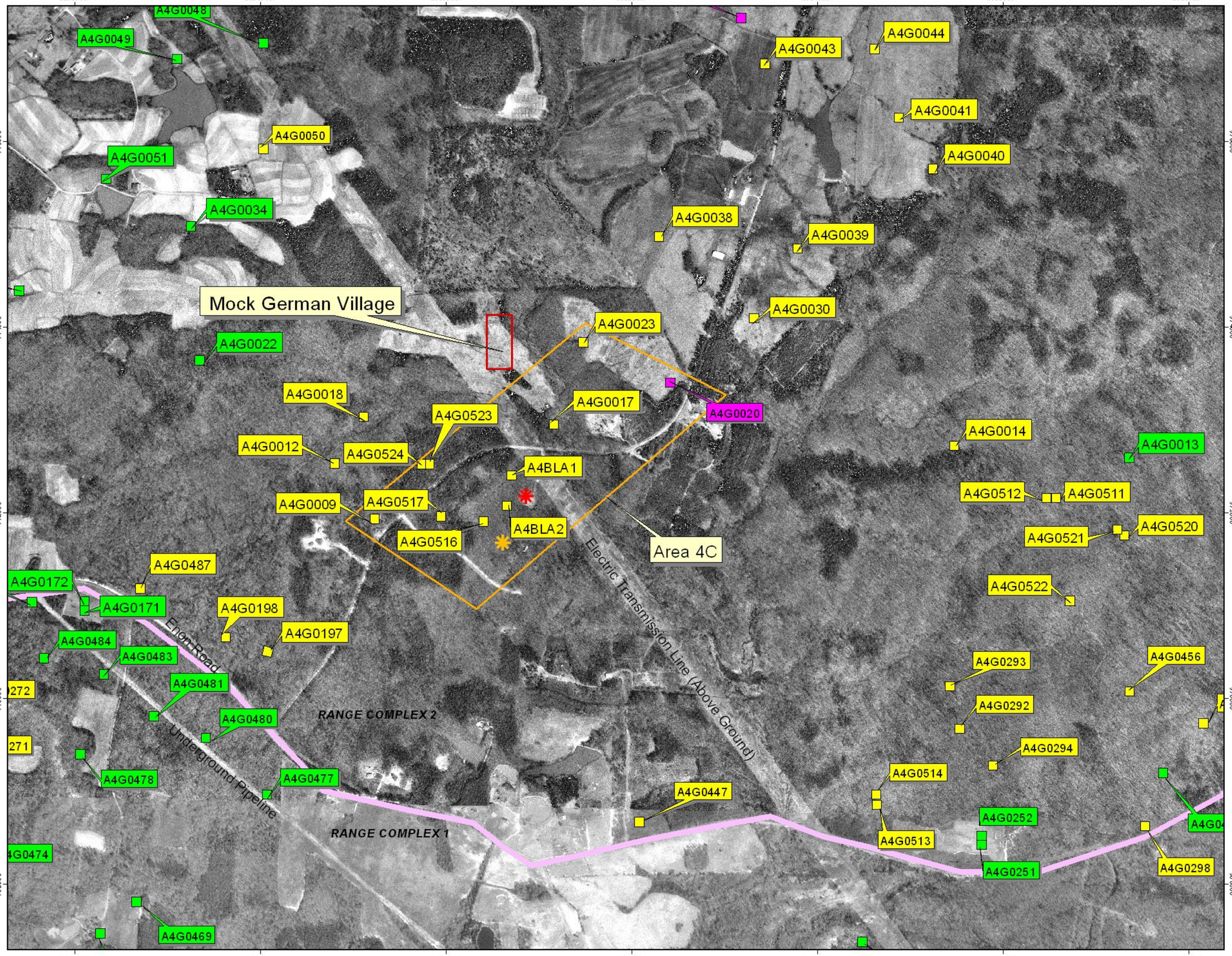
PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

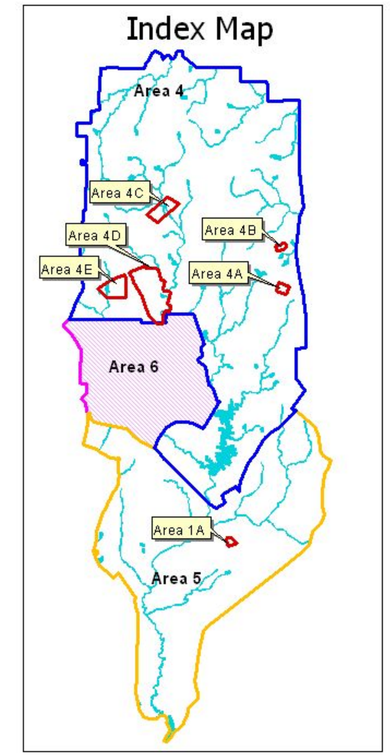
DESIGNED BY: BT	Completed Grids in Resectored Area 4A&4B	
DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 1,000 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-39
	FILE: x:\gis\738001\av_project\EECA.apr	

Figure 3.11

Completed Grids in Resectored Area 4C

Former Camp Butner
Butner, NC





Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- Recent Non-EE/CA UXO Findings
- Recent Non-EE/CA OES Findings
- Possible Well Disposal Site
- UXO Findings 10 Years Ago

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

1000 0 1000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Completed Grids in Resectored Area 4C		
DRAWN BY: BT			
CHECKED BY: JK	SCALE: 1 inch equals 1,000 feet	PROJECT NUMBER: 738001	
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-40	
	FILE: x:\gis\738001\av_project\EECA.apr		

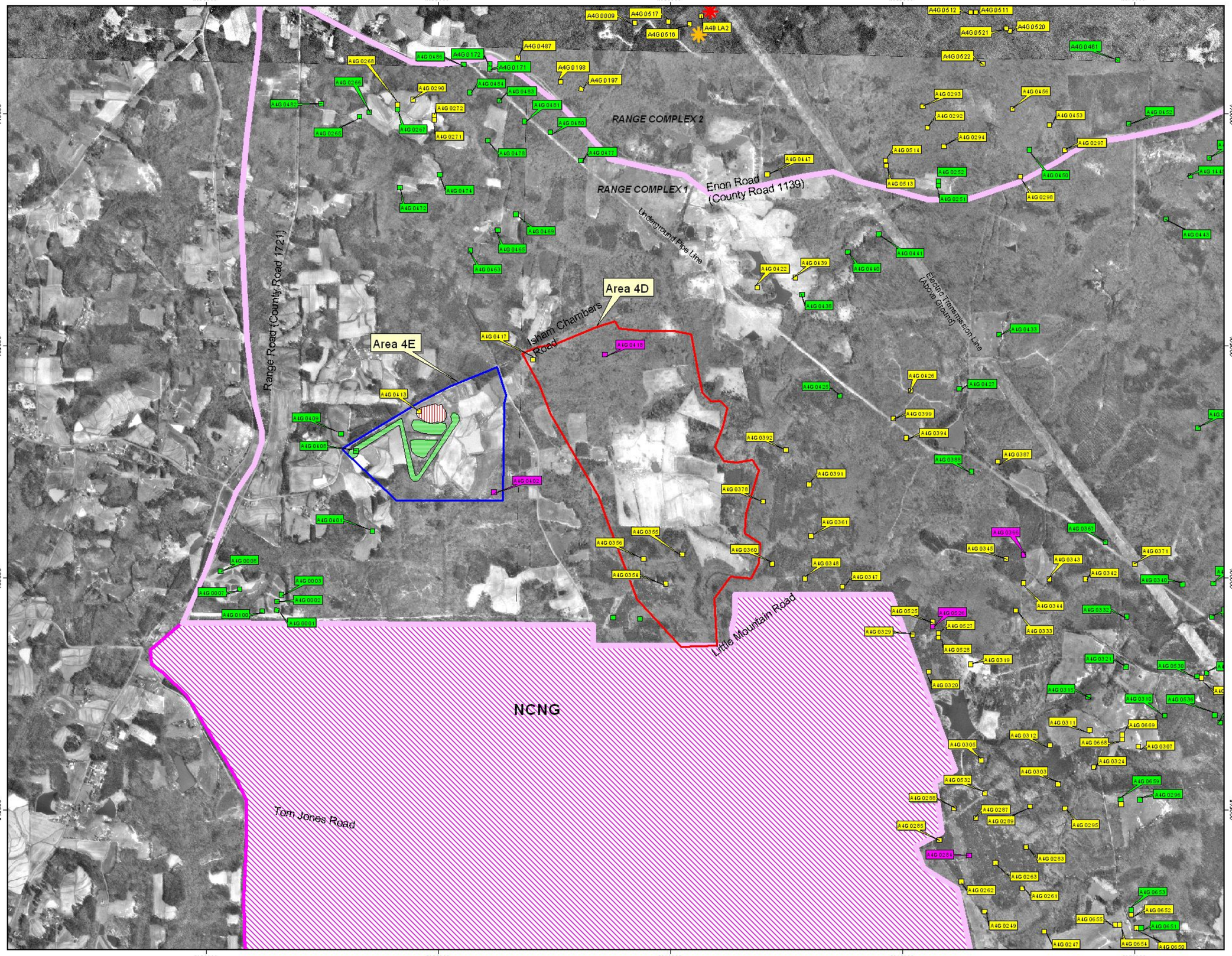
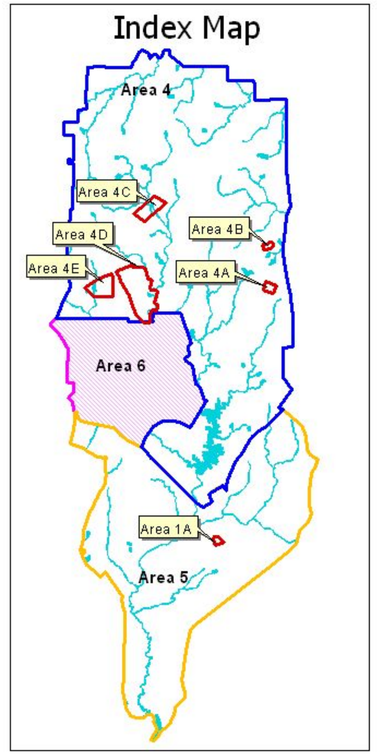


Figure 3.12

Completed Grids in Resectored Area 4D&4E

Former Camp Butner
Butner, NC

Index Map



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present

Aerial Photo Interpretation - USACE TEC, 2001

- Ground Scar
- Impact Crater
- Recent Non-EE/CA UXO Findings

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

2000 0 2000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT	Completed Grids in Resectored Area 4F&4G	
DRAWN BY: BT		
CHECKED BY: JK	SCALE: 1 inch equals 2,000 feet	PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004	PAGE: 3-41
	FILE: x:\gis\738001\av_project\EECA.apr	

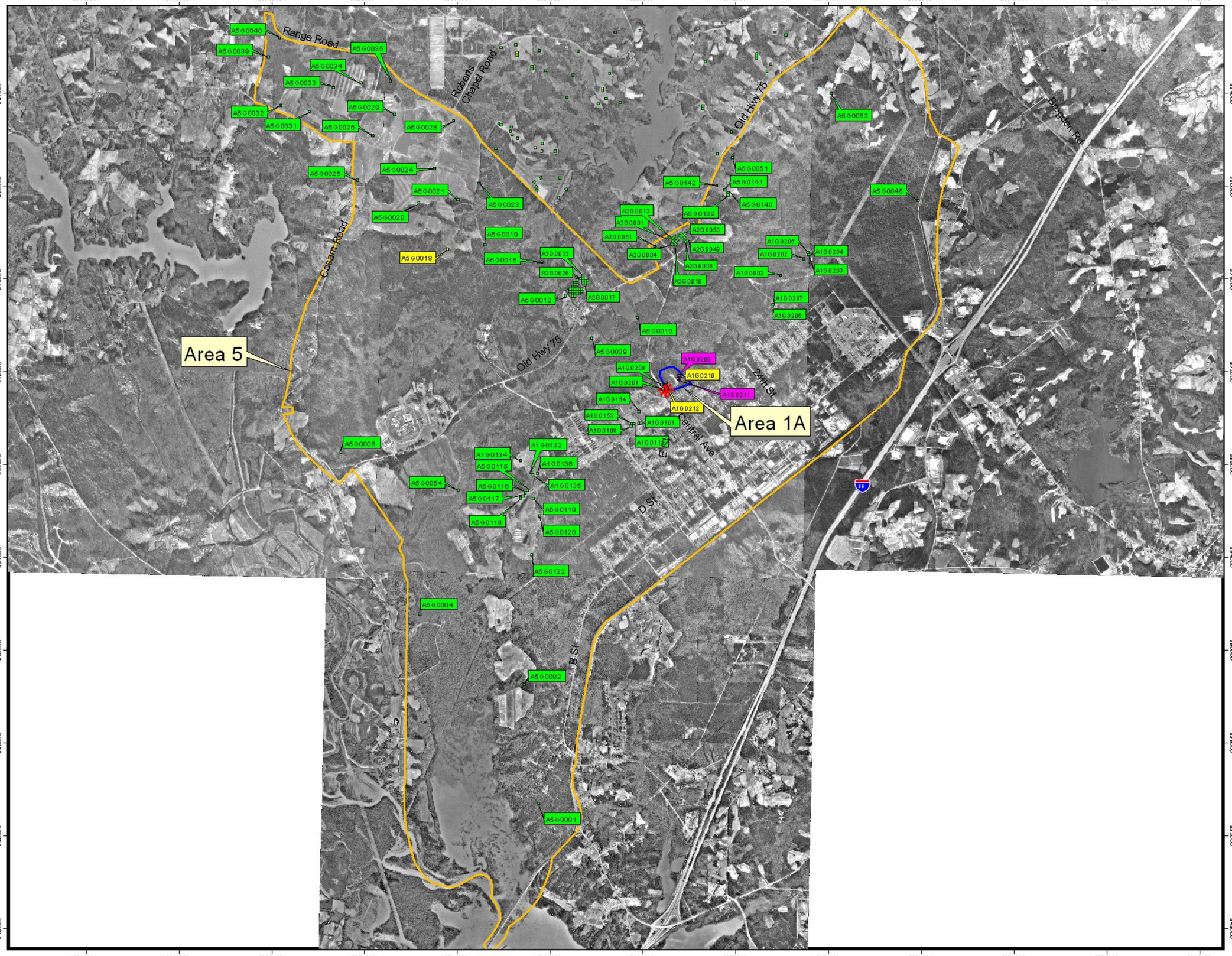
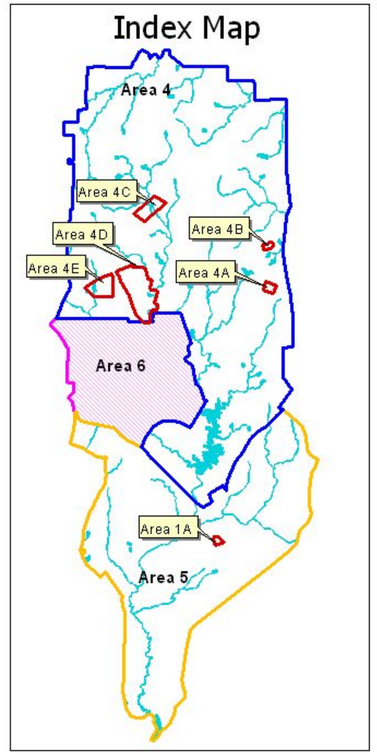


Figure 3.13

Completed Grids in Resectored Area 5

Former Camp Butner
Butner, NC

Index Map



Legend

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- Recent Non-EE/CA UXO Findings

Image Source: 1995 Aerial Photo from USGS
Map Units: NAD 1983 North Carolina State Plane (Feet)

4000 0 4000 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER
DESIGNED BY: BT	Completed Grids in Resectored Area 5
DRAWN BY: BT	
CHECKED BY: JK	SCALE: 1 inch equals 4,000 feet — PROJECT NUMBER: 738001
SUBMITTED BY: DS	DATE: July 2004 — PAGE: 3-42
	FILE: x:\gis\738001\av_project\EECA.apr

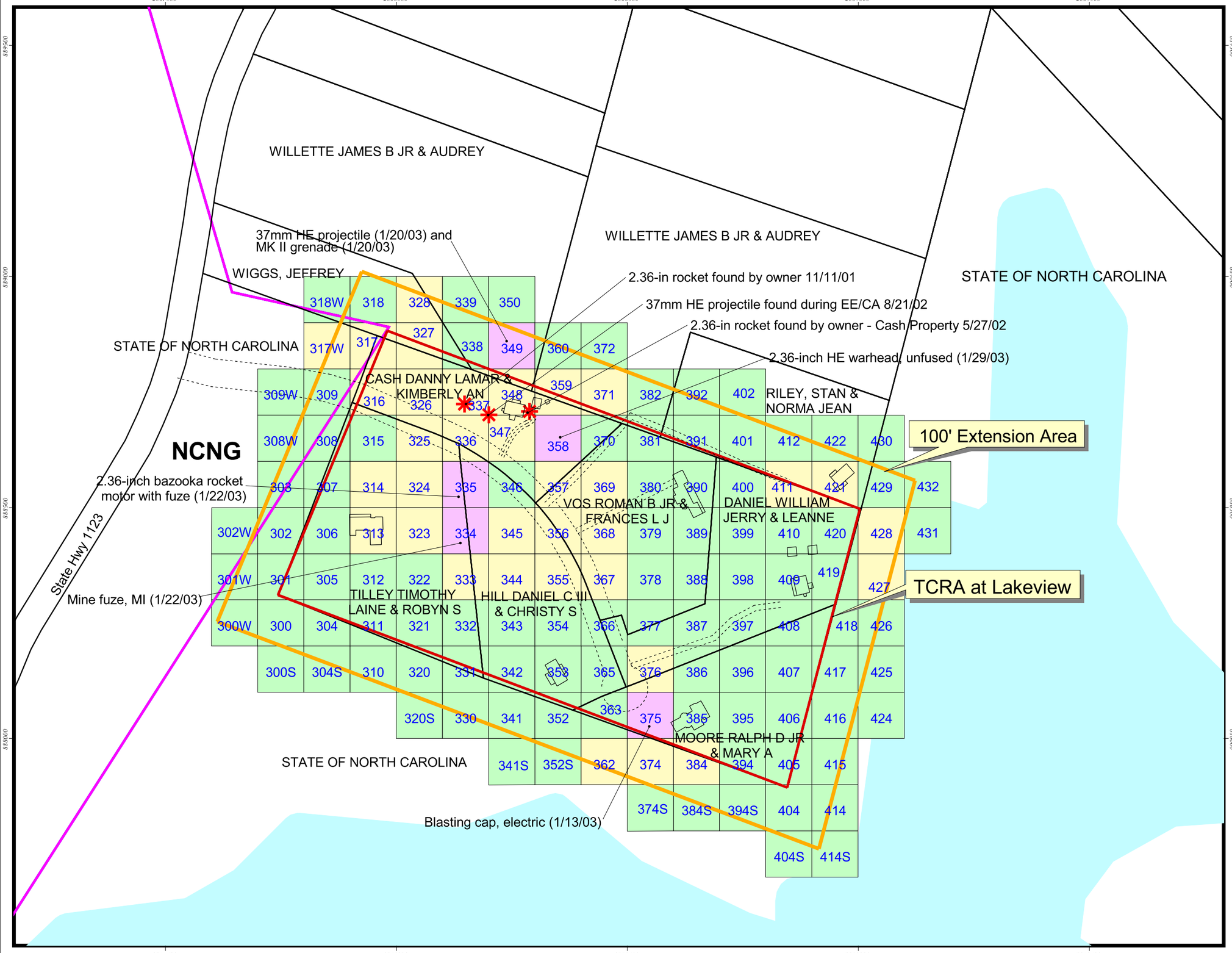
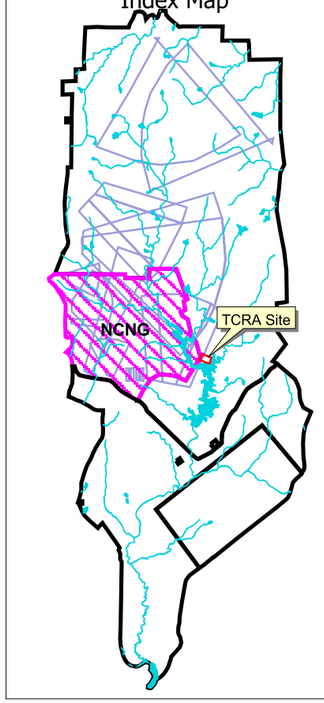


Figure 3.14

Intrusively Investigated Grid Locations

Former Camp Butner
Butner, NC

Index Map



Legend

- Firing Fan

100'x100' Grid

- Intrusively Investigated - No OES
- Intrusively Investigated - OES Present/No UXO
- Intrusively Investigated - UXO Present
- Waterbody (SDTS Data, Buffered 50 Feet)
- Recent Non-EE/CA UXO Findings

Map Units: NAD 1983 North Carolina State Plane (Feet)

100 0 100 200 Feet

N

PARSONS	U.S. ARMY CORPS OF ENGINEERS HUNTSVILLE CENTER

DESIGNED BY: BT
DRAWN BY: BT
CHECKED BY: DS
SUBMITTED BY: DS

Intrusively Inestigated Grid Location
Lakeview Subdivision

SCALE: 1 inch equals 200 feet
PROJECT NUMBER: 738001
DATE: July 2004
PAGE: 3-43
FILE: x:\gis\738001\av_project\investigated_grids.apr

CHAPTER 4
RISK EVALUATION

4.1 INTRODUCTION

4.1.1 A qualitative risk evaluation was conducted using the OE Risk Impact Assessment (OE RIA) for OE EE/CA Evaluations Interim Guidance document (USACE, 2001b) to assess explosive safety risk to the public at the former Camp Butner Site. The purpose of the risk evaluation is to communicate the magnitude of the risk at the site and the primary causes of that risk, and to aid in the development, evaluation, and selection of OE response alternatives. The risk evaluation presented herein is based on the site characterization findings presented in Chapter 3 for each of the 9 AOIs remaining after re-sectorization (as described in Subchapter 3.5).

4.1.2 An explosive safety risk is the probability for a UXO to detonate and potentially cause harm as a result of human activities. An explosive safety risk exists if a person can come near or into contact with a UXO and act on it to cause a detonation. The potential for an explosive safety risk depends upon the presence of three critical elements: a source (presence of UXO), a receptor or person, and interaction between the source and receptor (such as picking up the item or disturbing the item by plowing). There is no risk if any one element is missing. Each of the three elements provides a basis for implementing effective risk-management response actions.

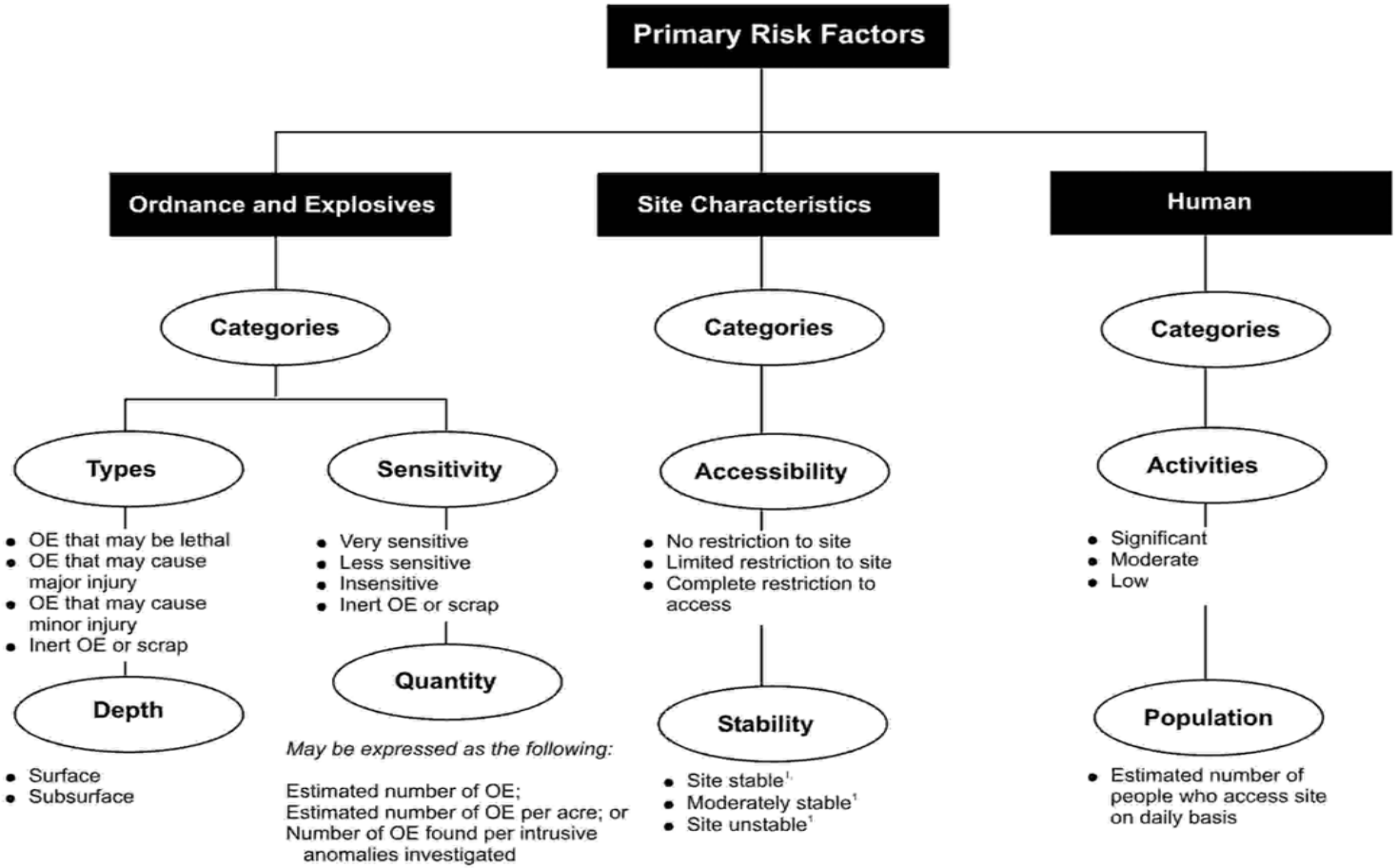
4.1.3 The exposure route for a UXO to a receptor is primarily direct contact as a result of some human activity. Agricultural or construction activities involving subsurface intrusion are examples of human activities that will increase the likelihood for direct contact with buried UXO. A UXO will tend to remain in place unless disturbed by human or natural forces, such as erosion or frost heave. Movement of the UXO may increase the probability for direct human contact but not necessarily result in a direct contact or exposure.

4.2 DEFINITION OF RISK EVALUATION FACTORS, CATEGORIES, AND SUBCATEGORIES

4.2.1 Introduction

The potential risk posed by UXO was characterized qualitatively by evaluating three primary risk factors. The three primary risk factors include: 1) presence of a UXO source, 2) site characteristics that affect the accessibility or pathway between the source and human receptor, and 3) human factors that define the number of receptors and type of activities that may result in direct contact between a receptor and UXO source. By performing a qualitative assessment of these three factors, an overall assessment of the safety risk posed by UXO was evaluated. The following paragraphs describe the components of each of the primary risk factors and an overview of the risk evaluation factors is shown in Figure 4.1.

Figure 4.1
OE Risk Factor Tree



Notes
1. Function of type of activities/use and depth of OE.
2. Bulleted items are subcategories for each category.

4.2.2 Presence of UXO Factors

4.2.2.1 There are four categories that are used to evaluate the presence of UXO risk. These include the UXO type, UXO sensitivity, UXO density, and UXO depth distribution.

4.2.2.2 Type. The UXO type affects the likelihood of injury and the severity of exposure. If multiple UXO items are identified in an area, that item which poses the greatest risk to public health is selected for risk evaluation. There are four subcategories of UXO type, as shown in Table 4.1. These subcategories are presented in order of severity from highest to lowest risk.

Table 4.1
UXO Type Subcategories

Subcategory	UXO Type Description
Most severe	UXO that may be lethal if detonated by an individual's activities
Moderate severity	UXO that may cause major injury to an individual if detonated by an individual's activities
Least severity	UXO that may cause minor injury to an individual if detonated by an individual's activities
No injury	Ordnance scrap (inert), will cause no injury

4.2.2.3 **Sensitivity.** UXO sensitivity affects the likelihood of detonation and the severity of exposure. Factors considered in evaluating sensitivity include fuzing and environmental factors such as weathering. There are four potential subcategories of UXO sensitivity. The category of sensitivity is based on the results of the EE/CA field investigation as well as the results of archival searches. When multiple subcategories of UXO types are discovered in an area, the highest risk subcategory is used in the risk evaluation. The subcategories of sensitivity are defined and presented in order from highest to lowest in Table 4.2.

4.2.2.4 **Density.** UXO density affects the likelihood that an individual will be exposed to UXO. There exists a direct relationship between density and potential for harm. For example, the more ordnance per acre, the greater the likelihood of exposure to a UXO item and thereby an opportunity to create an incident. Density can be estimated either qualitatively or quantitatively.

Table 4.2
UXO Sensitivity Subcategories

Subcategory	UXO Sensitivity
Very Sensitive	UXO that is very sensitive, i.e., electronic fuzing, land mines, booby traps
Less sensitive	UXO that has standard fuzing
Insensitive	UXO that may have functioned correctly, or is unfuzed, but has a residual risk
Inert	Ordnance scrap (inert), will cause no injury

4.2.2.5 **Depth Distribution.** The UXO depth distribution refers to where the UXO is located vertically in the subsurface. The UXO depth distribution affects the likelihood that an individual will be exposed to UXO. There exists a direct relationship between the depth at which UXO are found and the likelihood of exposure to the UXO. That is, the greater the depth where the UXO are found, the lower the risk of exposure. There are two subcategories within the UXO depth distribution category: surface and subsurface. The surface subcategory includes those items recovered either on the ground surface, protruding from the ground surface, or beneath the leaf litter. The subsurface subcategory includes those items recovered from beneath the ground surface. Assessment of this risk category reflects the findings of the EE/CA field investigation.

4.2.3 Site Characteristics Factors

4.2.3.1 There are two categories that are evaluated in the site characteristics risk factor. These are site accessibility and site stability.

4.2.3.2 **Site Accessibility.** The accessibility of a sector affects the likelihood of encountering UXO. Natural or physical barriers can limit the accessibility. Natural barriers can include the terrain or topography of the site as well as the vegetation. Physical barriers can include walls and fences that limit the publics' accessibility to the sector. Both the physical and natural barriers found at a sector are considered when evaluating this category. Site accessibility has three subcategories. These subcategories are presented in Table 4.3.

4.2.3.3 **Site Stability.** This category relates to the probability of being exposed to UXO by natural processes. These natural processes include recurring natural events (e.g., frost heave, sand movement, erosion) or extreme natural events (e.g., tornadoes, hurricanes). The local soil type, topography, climate, and vegetation affect stability of the site. The soil type and climate primarily affects the depth of penetration of the UXO. Over time, the soil type and climate will also affect the degree of erosion that takes place at a site. Topography and vegetation in the area will also affect the rate of erosion that takes place in an area. Site stability has three subcategories. Table 4.4 describes these subcategories.

Table 4.3
Site Accessibility Subcategories

Subcategory	Accessibility Description
No Restriction to Site	No man-made barriers, gently sloping terrain, no vegetation that restricts access, no water that restricts access
Limited Restriction to Access	Man-made barriers, vegetation that restricts access, water, snow or ice cover, and/or terrain restricts access
Complete Restriction to Access	All points of entry are controlled

Table 4.4
Site Stability Subcategories

Subcategory	Stability Description
Site Stable	UXO should not be exposed by natural events
Moderately Stable Site	UXO may be exposed by natural events
Site Unstable	UXO most likely will be exposed by natural events

4.2.4 Human Factors

4.2.4.1 There are two categories that are evaluated in the primary human risk factor. These include activities and population.

4.2.4.2 **Site Activity.** The types of activities conducted at a site affect the likelihood of encountering UXO. The types of activities may be generally classified as recreational and occupational. This category examines whether the impact from an activity on UXO is significant, moderate or low. In order to assign such a score, the general guidelines presented in Table 4.5 were considered. First, the type of activity should be identified. Then, the depth of the activity must also be considered. For example, at a site where UXO is at the surface, all activities that can impact UXO at the surface are considered activities that have significant impact or contact level. Conversely, if all UXO is located at depths greater than 1 foot and only surface impact activities are being performed then the activities are considered as moderate or low impact. After the type of activity and depth of UXO are identified, then a score of significant, moderate or low may be assigned.

Table 4.5
UXO Contact Probability Levels

Examples of Activities	Actual Depth of UXO	Contact Level
Child Play, Picnic, Short Cuts, Hunting, Fishing, Hiking, Swimming, Jogging, Ranching, Surveying, Off-Road Driving,	Surface Below Surface -12” >12”	Significant Low Low
Camping, Metal Detecting	Surface Below Surface -12” >12”	Significant Moderate Low
Construction, Archaeology, Crop Farming	Surface Below Surface -12” >12”	Significant Significant Moderate

4.2.4.3 Population. This category refers to the number of people that potentially access the AOI on a daily basis. The number of people using the AOI affects the likelihood of encountering UXO. A direct relationship exists between the number of people and the risk of exposure. An estimate of the number of people accessing the AOI on a daily basis was made using census data and best professional judgment based on knowledge of the type of site, land use, and site accessibility.

4.3 RISK EVALUATION

4.3.1 Introduction

Each of the primary risk factors identified above was evaluated using the data collected during the EE/CA field investigation, the data presented in the ASR, and the results of the TCRA. The risk evaluation for the 11 AOIs is presented in Table 4.6. The following sections discuss the risk evaluation by each primary risk factor.

4.3.2 Presence of UXO Factor

4.3.2.1 Type

4.3.2.1.1 **Area 1A:** Two UXO items were recovered during the EE/CA investigation in Area 1A. One Mk II hand grenade was recovered at a depth of 1 inch and a M1 practice anti-tank landmine with spotting charge and fuze was recovered at a depth of 10 inches. The ASR report indicated that a small arms range and flamethrower range was located in this area. During the ASR site visit small arms ammunition casings (.30 caliber) were identified. Ordnance items that are 30mm and smaller are classified as small arms by the U.S. Military (USACE, 1994). These items pose a very low explosive safety risk and are not considered a UXO hazard. For small arms, a deliberate effort must be applied to a very specific and small point (the primer) to make the round function. If the round functions outside the weapons chamber, the propellant gas would cause the bullet and cartridge to separate and, in addition, the cartridge could also rupture. If this took place in close proximity to a person, possible injury could result (USACE, 1999).

The explosive safety risk posed by small arms ammunition is very small and is not further discussed in this report

4.3.2.1.2 During this EE/CA investigation, a 2.36-inch rocket was reportedly found in unknown condition near the water tower and detonated by Fort Bragg EOD. Although this potential UXO was found within the confines of Area 1A, it cannot be confirmed as UXO and is uncharacteristic of the items observed within Area 1A during the EE/CA. Based on the verified UXO (grenade and practice mine), the Mk II hand grenade was selected as the munition of most concern for Area 1A and was assigned a subcategory of "most severe" because it may be lethal if detonated by an individual's activities.

4.3.2.1.3 **Area 4A:** One UXO item was recovered in Area 4A during this EE/CA investigation. One 2.36-inch HE bazooka rocket was recovered at a depth of 3 inches. Area 4B is located entirely within one of six areas restricted for 'surface use only' when the government sold the land back to the public (see paragraph 2.3.6, Figure 2.3). Area B was designated as a bazooka and rifle grenade impact area in historical records. The UXO findings corroborate this historical designation. The 2.36-inch HE bazooka rocket was assigned a subcategory of "most severe" because it may be lethal if detonated by an individual's activities.

4.3.2.1.4 **Area 4B:** One UXO item was recovered in Area 4B during this EE/CA investigation. One 2.36-inch HE bazooka rocket was recovered at a depth of 18 inches. In addition, coincident with the EE/CA investigation, the property owner uncovered an inert 2.36-inch bazooka rocket. Area 4B is located entirely within one of six areas restricted for 'surface use only' when the government sold the land back to the public (see paragraph 2.3.6, Figure 2.3). Area 4B was reportedly within a bazooka and rifle grenade impact area. The UXO findings corroborate this historical designation. The 2.36-inch HE bazooka rocket recovered during the EE/CA investigation was assigned a subcategory of "most severe" because it may be lethal if detonated by an individual's activities.

4.3.2.1.5 **Area 4C:** One UXO item was recovered during the EE/CA investigation in Area 4E. One unfuzed 105mm HE projectile was recovered at a depth of 3 inches. Additionally, an unfuzed 105mm HE projectile was recovered by a resident during this EE/CA investigation and disposed of by Fort Bragg EOD. A second projectile (155mm) was found by the resident during preparation of this report. This item was also disposed of by Fort Bragg EOD. Another adjacent resident reported finding a 155mm HE projectile approximately 10 years ago; however this item was not verified. Area 4C is located within one of six areas restricted for 'surface use only' when the government sold the land back to the public (see paragraph 2.3.6, Figure 2.3). Area 4C falls within the main artillery impact area. The TEC historical photographic analysis identified a large number of suspect impact craters in this area. In addition, the ASR report identified the structural remnants of the mock German village used as an artillery target and was later verified by Parsons' personnel during this EE/CA investigation. The 155mm HE projectile (UXO item) was assigned a subcategory of "most severe" because it has the potential to cause the most injury if detonated by an individual's activities.

4.3.2.1.6 **Area 4D:** One UXO item was recovered during the EE/CA investigation in Area 4D. One 37mm HE projectile was recovered at a depth of 2 inches. This AOI is

located within the former Range 10 (37mm projectile training) and Range 11 (60mm mortar training) impact areas. Area 4D ***does not*** fall within any of six areas restricted for 'surface use only' when the government sold the land back to the public (see paragraph 2.3.6, Figure 2.3). The 37mm projectile identified during this EE/CA investigation corroborates the historical designation of this AOI. The UXO item was assigned a subcategory of "most severe" because it may be lethal if detonated by an individual's activities.

4.3.2.1.7 **Area 4E:** One UXO item was recovered during the EE/CA investigation in Area 4E. One 37mm HE projectile was recovered at a depth of 1 inch. Area 4E is located almost entirely within one of six areas restricted for 'surface use only' when the government sold the land back to the public (see paragraph 2.3.6, Figure 2.3). Area 4E falls within the area reportedly used as a moving target area within the former Range 10 (37mm projectile training range). The 37mm HE projectile (UXO item) was assigned a subcategory of "most severe" because it may be lethal if detonated by an individual's activities.

4.3.2.1.8 **Area 4:** Five UXO and 1118 ordnance scrap items were identified during the EE/CA investigation in Area 4. The peripheries of several firing ranges are located throughout this AOI. The UXO items included one 105mm HE projectile recovered at the surface, one 57mm HE projectile recovered at a depth of 6 inches, one unfuzed 2.36-inch HE bazooka rocket recovered at a depth of 10 inches, an unfuzed 155mm shrapnel projectile with expelling charge recovered at a depth of 30 inches, and a M52 series nose fuze recovered at a depth of 3 inches. The likelihood for occurrence of additional UXO within this AOI is considered moderate based on both the number of UXO and ordnance scrap items found as well as the configuration of historical firing ranges. The unfuzed 155mm projectile and the 105mm HE projectile recovered during this EE/CA were selected as the munitions of most concern for Area 4 and assigned a subcategory of "most severe" because they may be lethal if detonated by an individual's activities. Note, however, that the 57mm HE projectile also meets the criteria for the subcategory of "most severe".

4.3.2.1.9 Historical photographic analysis by TEC identified a large concentration of suspect impact craters along the northern and eastern portions of Area 4 (adjacent to the NCNG property) as well as much of the northcentral portion of the AOI near the Mock German Village (USACE, 2001a). This AOI includes the former Range 10 (37mm projectile training) and former Range 14 (60mm mortar training) impact areas as well as the heavy artillery target areas. All or part of each of the six parcels restricted for 'surface use only' when the government sold the land back to the public fall within Area 4 (see paragraph 2.3.6, Figure 2.3). The large quantity of ordnance scrap items and UXO recovered in this area during the EE/CA investigation corroborate the historical usage of this AOI as an artillery impact area.

4.3.2.1.10 **Area 5:** No UXO was identified during the EE/CA investigation in Area 5. Only one ordnance scrap item was recovered from the 750 anomalies that were intrusively investigated. The ASR report indicated that the cantonment area and small arms ammunition training range were located within this AOI. Area 5 ***does not*** fall within any of the six areas restricted for 'surface use only' when the government sold the land

back to the public (see paragraph 2.3.6, Figure 2.3). The findings from this EE/CA corroborate the historical use of this AOI. The likelihood for occurrence of UXO within this AOI is considered remote based on the findings from this EE/CA investigation. The ordnance scrap item recovered in this AOI is assigned a subcategory of "no injury".

4.3.2.1.11 **Lakeview Subdivision:** One UXO item was recovered during the EE/CA investigation and six UXO items were recovered during the TCRA in the Lakeview Subdivision. The Lakeview Subdivision ***is not*** located within any of six areas restricted for 'surface use only' when the government sold the land back to the public (see paragraph 2.3.6). A 37mm HE projectile was recovered from a depth of 3 inches during the EE/CA. During the TCRA, UXO items recovered include one electric blasting cap, one Mk II hand grenade, one 37mm HE projectile, one M1 A1 mine fuze, one 2.36-inch bazooka rocket motor with fuze, and one 2.36-inch HE bazooka rocket warhead. All the UXO items recovered during the TCRA were between a depth of 1 – 6 inches. The Mk II hand grenade was assigned a subcategory of "most severe" because it has the potential to cause the most injury if detonated.

4.3.2.2 Sensitivity

A subcategory of "less sensitive" was assigned to Areas 1A, 4A, 4B, 4D, 4E, and the Lakeview Subdivision based on the recovery of munitions in these areas having standard fuzes as defined in Table 4.2. Sensitivity affects the likelihood of detonation and the severity of exposure. The UXO items recovered during this EE/CA in Area 4C did not have intact fuzing as a result of shearing at impact. However, there is a reasonable likelihood that other UXO items may exist in these areas within intact fuzing; therefore, a subcategory of "less sensitive" was also assigned to Area 4C. The UXO sensitivity for Area 4 was also assigned "less sensitive" based on the presence of projectiles with standard fuzing. Area 5 was assigned a subcategory of "inert", as only ordnance scrap that can not cause any injury was recovered in this area.

4.3.2.3 Density

Density was estimated qualitatively for the each AOI based on the number of UXO found and the number of acres investigated. No UXO were found in Area 5. A total of 13 UXO items were recovered during the EE/CA investigation and 6 UXO items were recovered during the TCRA in the Lakeview Subdivision. In addition, during the EE/CA investigation, two verified UXO items were recovered by a resident at unspecified depths in Area 4C and one verified UXO item was recovered by another resident at an unspecified depth in Area 4B.

4.3.2.4 Depth

4.3.2.4.1 The UXO depth distribution affects the likelihood that an individual will be exposed to UXO. There is a direct relationship between the depth at which UXO are found and the likelihood of exposure to the UXO. There are two subcategories within the distribution depth category: surface and subsurface (as defined in paragraph 4.2.2.5). No UXO were found in Area 5. The depth distribution factor is not applicable to this area. The 13 UXO items found at the former Camp Butner Site during the EE/CA investigation ranged in depth from 0 – 30 inches (one suface UXO in Area 4). The 6 UXO items recovered during the TCRA at the Lakeview Subdivision ranged in depth from 1 inch – 6

inches. It should be noted that the depth distribution of the UXO items found during the TCRA is biased because the TCRA was limited to between 0 – 6 inches.

4.3.2.4.2 Table 4.6 summarizes the results of the EE/CA and TCRA investigations in terms of the depth of UXO for each area.

4.3.3 Site Characteristics Factors

4.3.3.1 Site Accessibility

All areas investigated during the EE/CA are accessible by both road and foot. There are mountainous areas and densely wooded areas with thick understory scattered throughout the entire site that limits easy access. The terrain in portions of Area 4 (north and east of NCNG) and Area 4D are more rugged and remote than other areas in the former Camp Butner Site and provides a natural barrier that limits easy access to much of the area. Regions in Area 4 and Area 4D are also heavily forested and almost entirely undeveloped; however, hunters are known to frequent these areas. All areas are assigned a subcategory of no restriction as the entire area is accessible by road and foot. It should be noted, that the federal correctional facility, which encompasses a very small fraction of Area 5, is completely restricted.

4.3.3.2 Site Stability

The large amount of wooded area makes it possible that UXO may become exposed through natural processes, particularly burning initiated by lightning. In addition, frost heave (estimated at 4 inches, see also Subchapter 2.2.3) and localized erosion along creek banks over time may occur and potentially cause migration of subsurface UXO to the surface. The site stability is assigned a subcategory of moderately stable for the entire former Camp Butner Site.

4.3.4 Human Factors

4.3.4.1 Site Activities

4.3.4.1.1 The type of activities conducted at the former Camp Butner Site in combination with the depth distribution of UXO is related to the likelihood of individuals encountering UXO. Table 4.6 describes the type of activity expected in each AOI based on the current land use. The future land use is anticipated to continue along the existing land use tracks currently in place as discussed in Chapter 2.

4.3.4.1.2 Area 1A is a partially wooded undeveloped area. There are no residences within Area 1A; however, there is the potential for future recreational development (hiking trail) in this area. Current activities in this area are primarily trespassing and hiking. The detection of UXO (above the frost heave depth of 4 inches) combined with the potential for erosion results in a significant contact level rating for Area 1A.

4.3.4.1.3 Some of Area 4 and the majority of Area 4D is rugged, sparsely populated (few residential dwellings), and primarily used for hunting. Although hunting is a non-intrusive activity, the detection of UXO within the frost heave depth of 4 inches combined with the surficial hunting activity results in a significant contact level rating for

both areas. Other portions of Area 4 are largely open areas used primarily for farming. In these areas, the predominant agriculture activities include grazing, hay production, and seasonal tilling. The intrusive activities combined with the presence of UXO also supports the significant contact level rating assigned to Area 4.

4.3.4.1.4 Area 4A is largely wooded and undeveloped with a single private landowner (two residential dwellings). The property has recently been parceled in anticipation of future residential development and initial land clearing has been observed (July 2003). The planned future construction activities combined with recovery of UXO (above the frost heave depth of 4 inches) results in a significant contact level rating for Area 4A.

4.3.4.1.5 Area 4B is largely an open area used primarily for farming. There are two residential dwellings in this AOI. The current farming practice in this area, as reported by the property owner, includes tilling to a depth of approximately 10 inches. The intrusive activity combined with the presence of UXO results in a significant contact level rating for Area 4B.

4.3.4.1.6 Area 4C is partly residential (8 total residential dwellings) and partly undeveloped. The predominant activities include construction, child play, and hunting. The intrusive activities combined with the presence of UXO (above the frost heave depth of 4 inches) results in a significant contact level rating for Area 4C.

4.3.4.1.7 Area 4E is predominantly used for tobacco cultivation. There is one residential dwelling in the area. The predominant activities include farming and construction. The intrusive activities combined with the presence of UXO (above the frost heave depth of 4 inches) results in a significant contact level rating for Area 4E.

4.3.4.1.8 Five UXO were recovered in Area 4 and there is considered to be a moderate likelihood of occurrence for additional UXO based on the presence of impact craters, firing fans, and ordnance scrap items recovered in this area. Intrusive activities in Area 4 include child play, construction, farming, hunting, logging, and forestry. The moderate likelihood of occurrence for UXO in combination with the site activities, large size and population of the area results in an overall significant contact level rating for Area 4.

TABLE 4.6
RISK EVALUATION

AOI	Ordnance and Explosives Factors					Site Characteristics Factors		Human Factors		Summary
	Type[1]		**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population (Daily) /Number of Residential Dwellings**	**Qualitative OE RIA Safety Risk**
Area 1A	**EE/CA:** (1) M1 anti-tank practice landmine w/fuze, **(1) Mk II hand grenade**	Most Severe	Less Sensitive	2 in 1.15 acres	Surface – 0 Subsurface – 2	No Restriction	Moderately Stable	Significant (Trespassing and hiking)	0 – 5 /0	Moderate to High
Area 4A	**EE/CA: (1) 2.36-inch HE bazooka rocket**	Most Severe	Less Sensitive	1 in 1.15 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Construction, child play)	5 – 10 /2	High
Area 4B	**EE/CA: (1) 2.36-inch HE bazooka rocket** **Other:** (1) 2.36-inch bazooka rocket	Most Severe	Less Sensitive	1 in 0.7 acre	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Farming, child play)	2 – 5 /2	High
Area 4C	**EE/CA:** (1) unfuzed 105mm HE projectile **Other: (2) 155mm HE projectile**	Most Severe	Less Sensitive	1 in 2.3 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Construction, child play, hunting)	35 – 60 /8	High
Area 4D	**EE/CA: (1) 37mm HE projectile**	Most Severe	Less Sensitive	1 in 1.15 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Hunting, hiking, child play)	5 – 10 /6	Low to Moderate
Area 4E	**EE/CA: (1) 37mm HE projectile**	Most Severe	Less Sensitive	1 in 0.7 acre	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Farming and construction)	20 – 40 /1	Moderate

TABLE 4.6
RISK EVALUATION

AOI	Ordnance and Explosives Factors					Site Characteristics Factors		Human Factors		Summary
	Type[1]		**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population (Daily) /Number of Res. Dwellings**	**Qualitative OE RIA Safety Risk**
Area 4	**EE/CA: (1) 105mm HE projectile, (1) unfuzed 155mm shrapnel projectile with expelling charge,** (1) 57mm projectile, (1) unfuzed 2.36-inch bazooka rocket, and (1) M52 series nose fuze.	Most Severe	Less Sensitive	5 in 94.32 acres	Surface – 1 Subsurface – 4	No Restriction	Moderately Stable	Significant (Child play, construction, hunting, farming, forestry, logging)	500 – 750 /several hundred	Moderate
Area 5	**EE/CA:** Ordnance Scrap	No Injury	Inert	0 in 30 acres	Not Applicable	No Restriction	Moderately Stable	Low (Child play, construction, hunting, farming, forestry)	5000 – 8000	Low
Lake-view Sub-divi-sion	**EE/CA:** (1) 37mm HE projectile **TCRA:** (1) electric blasting cap, **(1) MkII hand grenade**, (1) 37mm HE projectile, (1) M1 A1 Mine fuze, (1) 2.36-inch HE rocket motor w/ fuze, (1) 2.36-inch HE bazooka rocket warhead	Most Severe	Less Sensitive	**EE/CA**: 1 in 0.7 acre **TCRA**: 6 in 26 acres	Surface – 0 Subsurface – 7	No Restriction	Moderately Stable	Significant (Construction, child play)	30 – 50 /7	High

[1] Denotes items found during the EE/CA and TCRA investigations, as indicated. Other denotes items found by residents and disposed of by Fort Bragg EOD during the EE/CA investigation.

The bolded UXO item was used to establish the Category.

[2] Denotes the number of UXO items found at the surface and in the subsurface during the EE/CA field investigation and TCRA. The TCRA removal was limited to the upper 6 inches.

4.3.4.1.9 No UXO was recovered in Area 5. There is considered to be a remote likelihood of occurrence for UXO in Area 5 based on the absence of firing fans, very few impact craters, and lack of ordnance scrap findings during the EE/CA investigation. Intrusive activities in Area 5 include child play, construction, farming, hunting, forestry. The remote likelihood of occurrence for UXO in combination with the site activities results in an overall low contact level rating for Area 5.

4.3.4.1.10 The Lakeview Subdivision area is a residential area that presently contains seven residences with one additional residence under construction. The primary activities in this area include construction and child play. The intrusive activities combined with the potential presence of residual UXO in the subsurface results in a significant contact level rating for the Lakeview Subdivision.

4.3.4.2 Population

The population living within the former Camp Butner is low. The 2000 census indicates the majority of people live in the Town of Butner in Area 5 and along the western and southern perimeter of Area 5. Additional concentrations of people are located throughout the site distributed along the main roads. The number of people that potentially access an AOI on a daily basis was estimated using professional judgment, site reconnaissance, and census data.

4.4 RISK ASSESSMENT SUMMARY

4.4.1 The risk to public safety associated with the presence of UXO were evaluated for each of the AOIs. The explosive safety risk is due to a combination of each of the primary risk factors that are presented above. The ASR report indicated that over 1000 UXO items were recovered during the dedudding operations in 1949 and 1950 (USACE, 1997). Following the dedudding operations, the government conveyed property in six areas with a ‘surface use only’ deed restriction and recommended periodic inspection of these areas (Figure 2.3). The periodic inspections in the six restricted areas (encompassing much of Area 4 proper as well as most or all of Area 4A-4E, except Area D) were conducted through 1969 and the ASR documented the recovery and destruction of over 100 additional UXO items. UXO items can be lethal if detonated by an individual’s activities.

4.4.2 Despite the dedudding operation and periodic inspections, nineteen UXO items were identified both on the surface and subsurface in the AOIs during this EE/CA investigation and recent TCRA. Even though a removal action has been completed within the Lakeview Subdivision, a residual risk still remains because the removal actions were not completed to depth (TCRA limited to 6 inches bgs) and potential residual subsurface UXO may become exposed in the future as a result of natural events (erosion or frost heave) and/or human activities.

4.4.3 The explosive safety risk in Area 1A is considered moderate to high. Two UXO items were identified during the EE/CA and an additional ordnance discovery was

reported by an area resident. Although there are no residents living within this AOI, potential receptors include area residents, hikers, and trespassers. Potential future construction as a result of the encroachment from the Town of Butner and planned future passive recreational use for this area contributes to the explosive safety risk.

4.4.4 The explosive safety risk in AOIs Area 4A, Area 4B, and Area 4C is high. UXO items were identified during this EE/CA investigation in these AOIs. The property in each of these areas were originally sold back to private individuals with a 'surface use only' deed restriction because of the potential for residual UXO. Despite the 'surface use only' deed restriction, intrusive agricultural activities and significant recent residential development has occurred. Ongoing agricultural practices and additional future residential development contribute to an explosive safety risk for the area residents and workers.

4.4.5 The explosive safety risk in Area 4D is considered low to moderate. The terrain is heavily vegetated and mostly frequented by hunters. Only five residential dwellings have been identified within this AOI. The primary activities are non-intrusive and include hunting and hiking.

4.4.6 The explosive safety risk in Area 4E is considered moderate. The land is used primarily for agricultural purposes and has been tilled for several decades without an incident. Only one residential dwelling has been identified within this AOI.

4.4.7 The explosive safety risk in Area 4 is considered low to moderate. Five UXO were recovered during the EE/CA investigation and there is considered to be a moderate likelihood for additional occurrence of UXO based on the configuration of firing fans. The unrestricted access, intrusive agricultural activities and potential for future development (in some areas) contribute to the explosive safety risk.

4.4.8 The explosive safety risk in Area 5 is low. Only one ordnance scrap item was recovered during the EE/CA investigation in Area 5; no UXO was found. The ASR report indicated that this portion of former Camp Butner was used as a cantonment area and also for small arms ammunition training. The archival evidence does not indicate the presence of any firing ranges and the likelihood for occurrence of any UXO is considered remote.

4.4.9 The explosive safety risk in the Lakeview Subdivision is high. Multiple UXO items were recovered during the EE/CA and the TCRA in this area. The area is residential (7 residential dwellings) with unrestricted access. Intrusive activities include child play and construction. Additional residential construction and residential activities contribute to the post-TCRA residual explosive safety risk in this AOI.

CHAPTER 5
INSTITUTIONAL ANALYSIS

5.1 INTRODUCTION

Parsons prepared an Institutional Analysis (IA) Report as part of the former Camp Butner Site EE/CA Report. The IA was performed in accordance with USACE guidance DID OE-100. The report supports the development of institutional control (IC) alternative plans for actions known as institutional control strategies, that are included in Chapter 7. These strategies rely on the cooperation of local and state authorities and private interest to protect the public at large from potential OE risks. The detailed IA is included in this report as Appendix F. The site-wide IC Plan will be prepared by the USACE CESAW Office subsequent to the public review period. This plan will provide details on the agreements relative to establishing, managing, and enforcing the specific IC recommendations presented in this EE/CA.

5.2 METHODOLOGY

The methodology used to analyze potential IC strategies for reducing the ordnance-related risk at the site included the review of government institutions and non-government entities that have some form of jurisdiction or ownership of the property within the site. Because the former Camp Butner Site extends over three counties and encompasses over 40,000 acres, multiple entities exercise control throughout the various regions of the site including: Durham County Sheriff, Granville County Sheriff, Town of Butner Public Safety, and North Carolina Department of Agriculture and Consumer Services. Interviews were conducted to determine the capabilities and willingness of these public agencies to support and enforce short and long-term IC measures. A list of the agencies interviewed and interview results is provided Appendix F. The information gathered during discussions with these agencies was included in the development of the recommended IC strategies.

5.3 RECOMMENDATIONS

5.3.1 The recommended site-wide IC strategies have been selected as a result of discussions with the USACE; State, County, and City officials; Parsons' professional experience with institutional analysis; and overall knowledge of the site and site conditions. The recommendations are considered to be appropriate methods for reducing the risk of ordnance hazards to the public. The recommended alternatives are intended to be an effective complement to the response action alternatives discussed later in this document.

5.3.2 Upon implementation of the recommended IC components, public access should be restricted or limited in Area 1A until budgets and schedules allow removal actions in the affected area. For Areas 4A, 4B, and 4C (also recommended for removal actions) UXO construction support for new residential development is recommended until removal actions are implemented. Recommendations for the balance of Area 4 consider public education and awareness as the most practical response, so that the intended land-use (agricultural, hunting, hiking, and municipal activities) may continue with the inclusion of established institutional controls. In addition, UXO construction support for new residential development and removal actions encompassing the "footprint" of existing residential dwellings is recommended for all of Area 4 and its subsectors (discussed in detail in later chapters). The IC recommendations provided below have been recommended to most effectively inform the largest population, modify their behavior, and/or adequately restrict public access to areas of potential UXO contamination.

5.3.1 Notification During Permitting

5.3.1.1 The existing permitting procedures for zoning and building permits provide an excellent means to inform property owners regarding the potential presence of ordnance on their property. Currently, each county provides standard application forms and brochures that outline and explain the procedures involved in the zoning and building permit processes. The application for rezoning and/or building permits on properties within the former range area could include an affidavit stating that the owner has been informed that ordnance may be present on their property. No applications within the former Camp Butner areas would be accepted unless accompanied by the signed affidavit. This process would assure each jurisdiction that the applicant has been informed about the unexploded ordnance that may be located on his/her property. At the time of the writing of this report Granville County was actively developing a notification process.

5.3.1.2 The existing brochures that provide an explanation of the permit review and approval procedures could include a one-page information document that describes ordnance hazards. The document may include information on how to recognize ordnance and what procedures should be followed if ordnance is found on the site.

5.3.1.3 The proposed affidavit and information sheet can be prepared by the USACE and provided at no charge to the county. The county should agree to include the disclosure form in land development permitting. The cost for the initial documents would be approximately $500 and could be photocopied as needed by the counties and included in the rezoning, building permit, or utility permit application/information packet.

5.3.1.4 The proposed affidavit and information sheet would be distributed only to individuals applying for zoning, building permits, and utility permits on parcels of land located within the former Camp Butner. Each jurisdiction's computer system should have the capability of identifying these parcels via Geographic Information System (GIS) capabilities in planning and zoning departments. The cost to document all properties by

legal description, input this information into the county system, and train employees to use and provide the information is estimated to be between approximately $10,000 and $15,000.

5.3.2 Notification During Property Transfer

The filing of a disclosure document with the Registrar of Deeds Office provides an excellent means of informing the potential property owners about the potential for ordnance to exist within the former Camp Butner. The document would be filed under the names of all current owners of property within target and safety zones. When title searches are carried out pending the sale of property, information on the properties' history and the potential of ordnance would be made known.

5.3.3 Notification on Tax Bills

The insertion of notification of the potential for ordnance in all tax bills sent to property owners within the site is a very effective means of public education. The counties currently send tax forms through their tax offices; hence, very minimal addition to staffing will be required. This approach will inform property owners on a yearly basis of the potential for ordnance on their property. Additional expense to the county would be minimal.

5.3.4 Notification with Hunting Permit

The inclusion of notification of the potential for ordnance with the issuance of seasonal hunting permits provides effective public education for non-residents traversing areas of the site. This informative brochure would alert hunters to the potential hazard that may be encountered within the site. In addition, the document may include information on how to recognize ordnance and what procedures should be followed if ordnance is found on the site. Costs encurred to generate such notifications could be offset by the addition of a nominal fee to the cost of the permit.

5.3.5 Brochure/Fact Sheet

5.3.5.1 The existing fact sheet should be distributed to all property owners within the site. The names and addresses of all property owners have already been collected and are in digital format. The USACE or the counties could distribute the existing brochure to all property owners at a cost of less than $1,000.

5.3.5.2 Later in the EE/CA process, this existing fact sheet should be updated when additional details are available on the amount and location of ordnance, plans for removal, and institutional controls. The cost to prepare, print, and distribute the revised fact sheet is $10,000.

5.3.6 Newspaper Articles/Interviews

Positive newspaper articles that discuss the existence of ordnance, the potential danger, and how that danger can be minimized through education will serve as a very effective tool for educating the public at no cost to the county or the USACE.

5.3.7 Information Packages to Public Officials

The existing fact sheet and all proposed updates should be provided to public officials in Person, Granville, and Durham Counties. Local public officials will be invited to the public presentations of the EE/CA. These presentations will provide the officials with information they require. Copies of the EE/CA will also be made available to these individuals. The information packets should be updated to reflect current land use and zoning decisions.

5.3.8 Visual and Audio Media

5.3.8.1 An educational visual media program, approximately 7 to 10 minutes in length, will be prepared television, classroom, and community groups. Through television and classrooms, this program could reach a majority of the people in the region. The estimated cost of preparation of the visual media program and making adequate copies available is $26,000. The estimated annual cost to maintain the video and update it every 3 years averages $2,000 per year. The target audience should be youth from Kindergarten age to 18.

5.3.8.2 The use of local radio programming is also recommended to inform and educate the public about the history, current status, and future information concerning the presence of ordnance on the former range property. Local talk shows can be tapped to provide effective venues to have updates and discussions on ordnance safety. The existing and future fact sheets should be made available to the radio stations. Public service announcements on targeted, youth oriented radio stations are recommended, similar to no-smoking campaigns.

5.3.9 Classroom Education

Short presentations and courses in local schools and the community college are also recommended strategies to disseminate information. The 7 to 10 minute visual media video prepared for community groups can be used in the school presentations that are to be facilitated by the USACE. No additional expenses should be necessary for the schools. The USACE would have expenses of approximately $5,000 for the first year and $2,500 annually for future years.

5.3.10 Ad Hoc Committee

This committee of community leaders and other interested citizens will oversee the process for educating the public about the existence and potential danger of ordnance. It would be the responsibility of this committee to see that the other recommendations for public education are instituted and maintained. The cost to organize and maintain the committee is estimated at $2,000 for the first year with an ongoing annual cost of $1,000. A kickoff meeting for the creation of a Restoration Advisory Board (RAB) was conducted on May 25, 2004. The RAB will meet twice a year until the selected response actions are fully implemented.

5.3.11 Reverse 911 System

Investigate the use of a reverse 911 system with the county emergency management agency to address potential evacuations. This can be a joint police, fire, and Emergency Management System (EMS) function with various federal, state, and local dollars to purchase the system.

5.3.12 Signs

Signs can be posted along the perimeter of specific areas to warn the public about the risk of exposure to ordnance items. Signs can also include information regarding access restrictions, how to respond to discoveries of ordnance items, telephone numbers and addresses to contact with questions or concerns, and any other applicable site-specific information.

5.3.13 Fencing

Fencing would provide a physical barrier to prevent the public from entering specific areas and inadvertently coming in contact with ordnance. However, construction of fences is generally considered only as a last resort IC strategy due to generally negative public acceptance. The only AOI for which fencing was considered a viable option is Area 1A.

5.3.14 Land Use Restrictions and Regulatory Control

5.3.14 The current development patterns involving the ranges at the former Camp Butner necessitate that adequate notice of safety issues related to unexploded ordnance be provided through a variety of land use controls. It is recommended that planning and zoning officials revise their respective county comprehensive or master plan and zoning approval process to reflect knowledge associated with the former Camp Butner. GIS mapping and the development permit application process should be utilized as resources to convey information and regulate development in areas where unexploded ordnance has been located. Planning changes should be installed as "Smart Growth" or compact development techniques that minimize construction on target or safety zones. Where development does occur in target or safety zones, land use density for residential use should be low, or should be designated as green space, (i.e. conservation subdivisions).

5.3.15 Recordation of unexploded ordnance potential in individual deeds should be encouraged, but because of the difficulty in establishing whether individual ordnance is located on a particular parcel, mandatory deed recordation on individual parcels is not considered a viable land use control at properties comprising the former Camp Butner site.

5.3.15 Internet Website

Setup and maintenance of a website on the Internet about the former Camp Butner Site would provide another means of public information. The site would be effective to notify the public of changing site restrictions/activities. It would be inexpensive to create and would reach a broad cross section of the region.

CHAPTER 6
IDENTIFICATION OF RESPONSE ACTION OBJECTIVES

6.1 RESPONSE ACTION GOAL

6.1.1 Results from the EE/CA investigation identified one area as warranting an immediate (time-critical) UXO removal action. Intrusive sampling at this location was initiated by the reported finding of a 2.36-inch rocket by the property owner's child, which was subsequently identified as UXO by Fort Bragg EOD. Following the recovery of a 37mm HE projectile (UXO) during the EE/CA investigation, USAESCH deemed it necessary to conduct a TCRA at the Lakeview Subdivision (Appendix B; Parsons, 2003). The criteria of effectiveness, implementability and cost were used to evaluate the potential UXO removal action in accordance with USAESCH guidance. The goal of the TCRA was to minimize the explosive risk and achieve an acceptable level of protection to public safety and the human environment within a reasonable time frame.

6.1.2 No other AOIs within the former Camp Butner Site investigated as part of this EE/CA were initially identified as warranting an immediate (time-critical) UXO response action. However, fast track residential development in Area 4A warrants continued monitoring and periodic reevaluation. In addition, post-EE/CA UXO findings by a property owner in Area 4C (see paragraph 3.2.4.3) during the preparation of this report led to a second TCRA conducted by USAESCH and USA Environmental, Inc. Although a large amount of HE fragments were recovered, no UXO was identified. Several expended intact projectiles, including two 105mm smoke canisters and one 81mm mortar trench casing were also recovered. Preparation of a detailed reporting by USA is pending.

6.1.3 Non-time-critical OE response actions were evaluated for applicability at each AOI within the former Camp Butner Site. The goal of a non-time-critical UXO response action is public safety, which can be achieved by reducing the explosive threat posed by the UXO that potentially remains on the property. This goal was achieved by determining the appropriateness of a potential UXO response action for minimizing the public's exposure to UXO.

6.2 RESPONSE ACTION OBJECTIVES

6.2.1 A number of factors were considered for establishing the specific objectives for a response action. The objectives had to meet the requirements set forth in the applicable or relevant and appropriate requirements (ARARs) while still being realistic and achievable in terms of cost. To attain the goal of reducing the explosive threat posed by the potential for UXO/OE remaining within the former Camp Butner Site, the objectives identified had to be effective, implementable, and economical. The criteria

of effectiveness, implementability and cost were used to evaluate the potential UXO/OE response actions in accordance with USAESCH guidance.

6.2.2 The UXO/OE response action objectives guided the development of alternatives for the former Camp Butner Site and focused the comparison of potential UXO/OE response action alternatives. These objectives also assisted in clarifying the goal of minimizing the explosive risk and achieving an acceptable level of protection to public safety and the human environment. These objectives included:

- Identifying the degree and horizontal and vertical extent of UXO/OE presence;
- Evaluating the effectiveness of various response alternatives;
- Determining the ability to implement various response alternatives; and
- Determining the cost to implement the various response alternatives.

CHAPTER 7
IDENTIFICATION AND ANALYSIS OF UXO/OE RESPONSE ACTION ALTERNATIVES

7.1 INTRODUCTION

7.1.1 In this chapter, UXO response action alternatives are identified and analyzed for the nine AOIs, described in Subchapter 3.5, at the former Camp Butner Site. The alternatives are selected to achieve the UXO response action objectives discussed in Chapter 6. The identification of alternatives for the former Camp Butner Site included two principal groups: intrusive and non-intrusive. Non-intrusive alternatives included: the No DoD Action Indicated (NDAI) and IC alternatives; while intrusive approaches included surface and subsurface UXO clearance activities. This chapter provides a brief, general description of UXO clearance technologies. From this general description, four specific UXO response action alternatives for each sector are introduced and developed.

7.1.2 For each of the UXO response action alternatives identified, an analysis and screening was conducted against the three general categories of effectiveness, implementability, and cost to ensure that they met the minimum standards within each of the three categories. This screening was performed on UXO response action alternatives where UXO risk was identified. The purpose of this screening was to ensure that only viable UXO response alternatives were ranked against each other. Once this screening was completed, the remaining alternatives were compared against each other to identify the most appropriate UXO response action for each sector.

7.2 DESCRIPTION OF UXO CLEARANCE TECHNOLOGIES

7.2.1 Introduction

Various technologies and approaches exist for the clearance of UXO. A UXO clearance operation falls into three distinct areas: detection, recovery, and disposal. A discussion of the techniques used in each of these areas is presented in the following paragraphs.

7.2.2 UXO Detection

7.2.2.1 The detection of UXO includes those methods and instruments that can be used to locate UXO. The selection of the best technology depends on the properties of the UXO to be located, including whether the ordnance is likely to be found on the surface or below the surface and the characteristics of the location where the UXO is located, such as topography, vegetation, and geology.

7.2.2.2 Detection technologies have two basic forms. One form, visual searching, has been successfully used on a number of sites where UXO is located on the ground surface. When performing a visual search of a site, the area to be searched is divided into five-foot lanes that are then, systematically, inspected for UXO. A metal detector is sometimes used to supplement the visual search in areas where ground vegetation may conceal UXO. Typically, any UXO found during these searches is flagged or marked on a grid sheet for later removal.

7.2.2.3 The other form of UXO detection, geophysics, includes a family of detection instruments designed to assist in the location of UXO. This family of instruments includes magnetic instruments, electromagnetic instruments, and ground-penetrating radar. Each piece of equipment has its own inherent advantages and disadvantages based on its operating characteristics, making the selection of the type of geophysical instrument to be used on an UXO survey key to the success of the project. The equipment designed for UXO geophysical surveys is lightweight, easily maintained, and very effective. However, there are limitations to geophysics. Geophysical equipment cannot usually distinguish UXO items from other metallic objects located below the surface. "Cultural interference," such as underground utility lines, construction debris, or ferrous rock can result in a similar signature as UXO/OE. Therefore, it is necessary for the geophysical survey team to carefully document any known cultural interference while in the survey area. Another limitation to the equipment is that metallic objects have to be much larger when at greater depths so that the geophysical equipment can obtain a reading.

7.2.2.4 Various pieces of geophysical equipment were used during the EE/CA field investigation of the former Camp Butner Site. This equipment included the Geonics® EM-61 TDMD, Geonics® EM-61 MK 2 TDMD and Schonstedt® fluxgate magnetometers, as selected during the site-specific geophysical equipment prove-out (Parsons, 2002). While the technical characteristics and operating parameters of each of these pieces of equipment varied greatly, each was found to be effective in the specific application where the equipment was used in the field investigation.

7.2.3 UXO Recovery

7.2.3.1 Once a site has been surveyed by either visual or geophysical means, the recovery of UXO can begin. Recovery operations can take the form of a surface-only clearance of UXO, an intrusive (subsurface) clearance of UXO, or a combination of the two. The decision on the degree of clearance operation (depth and lateral extent) to engage in is based on the nature and extent of the UXO presence as well as the future use of the site.

7.2.3.2 During a surface clearance operation, UXO or suspected UXO on the ground surface, protruding from the ground, or beneath the leaf litter, are identified during the detection phase. Then the UXO are inspected, identified, and transported to a designated area for cataloging and eventual disposal. If it is determined during the inspection that the item cannot be safely moved, it would be destroyed in place.

7.2.3.3 During a subsurface clearance operation, buried UXO or suspected UXO identified by the geophysical survey or other detection methods requires excavation for removal. Because the actual nature of the buried UXO item cannot be determined without it being uncovered, non-essential personnel evacuations are necessary and may also include the use of engineering controls to ensure the safety of the operation. The excavation of the UXO item then takes place with either hand tools or mechanical equipment depending on the suspected depth of the object. Once the UXO item has been exposed, it is then inspected, identified, and transported to a designated area for cataloging and eventual disposal. If it is determined during the UXO inspection that the item cannot be safely moved, it would be destroyed in place.

7.2.3.4 Evacuations are sometimes necessary when conducting intrusive investigations to minimize the risk of the operation. The evacuation area will be within a predetermined MSD to ensure the safety of the operation. The MSD is initially based on the anticipated type of UXO that may be encountered and is adjusted for the actual identified UXO item prior to demolition activities. All non-essential/non-UXO personnel and the general public must be evacuated from and maintain their distance beyond the MSD during intrusive operations. The MSD may be reduced if appropriate engineering controls are applied, such as sandbag mounds and sandbag walls over and around the potential UXO item. However, evacuations may be required if excavations take place close to inhabited areas and engineering controls cannot reduce the MSD to preclude the need to evacuate. Available options will be explored, as appropriate, to minimize potential evacuations with the exception of compromising public safety.

7.2.4 UXO Disposal

7.2.4.1 Disposal of recovered UXO can take one of three different forms: off-site demolition and disposal; remote, on-site demolition and disposal; and in-place demolition and disposal. The decision regarding which of these techniques to use is based on the risk involved in employing the disposal option, as determined by the specific AOI characteristics and the nature of the UXO recovered.

7.2.4.2 If a UXO item is transported off-site for destruction, the UXO would be transported by either Army personnel or by a qualified UXO subcontractor. The UXO is typically transported to an active military installation where it can be safely destroyed. The transportation of OE is performed in accordance with the provisions of 49 CFR 100-199, TM 9-1300-206, and applicable state and local laws. A Transportation Plan detailing the route and procedures used during the transportation is prepared and approved prior to engaging in any off-site OE transport to ensure all safety aspects of the movement have been addressed. Off-site transportation of OE for destruction was not necessary during this investigation as all items designated as UXO were destroyed in place.

7.2.4.3 If UXO is discovered in proximity to occupied buildings it may not be possible to safely destroy the UXO item in place without the use of engineering controls. If an OE item is safe to move, it can be moved to a remote part of the project site where

demolition and disposal can safely take place. A countercharge can be used to destroy the UXO item.

7.2.4.4 Finally, an UXO item may be destroyed in place. This technique is typically employed when the UXO item cannot be safely moved to a remote location or if the UXO items are located in an area that is sufficiently remote. When employing this technique, procedures similar to those described above are used that will detonate the UXO item. When this technique is employed, engineering controls such as sandbag mounds and sandbag walls over and around the UXO item are often used to minimize the blast effects. All UXO recovered at the former Camp Butner Site during the EE/CA were destroyed in place due to safety concerns.

7.3 DESCRIPTION OF UXO/OE RESPONSE ACTION ALTERNATIVES

7.3.1 Introduction

7.3.1.1 The alternatives identified for evaluation were selected based on the results of the characterization activities performed at the former Camp Butner Site. Four alternatives were developed to address the explosive safety risk that remains at the site. These alternatives are as follows:

- Alternative 1 – No DoD Action Indicated (NDAI);
- Alternative 2 – Institutional Controls (ICs);
- Alternative 3 – Surface Clearance of UXO/OE; and
- Alternative 4 – Clearance of UXO/OE to Depth.

7.3.1.2 Implementation of a recurring review program (see Chapter 10) was not evaluated as a separate alternative, but will be an integral part of any alternative. The recurring review program will be used in conjunction with the UXO/OE clearance alternatives. As part of this program, visual surveys will be performed on a proposed schedule to ensure that appropriate site safety and security measures remain in place and the integrity of any site controls is maintained. These visual surveys will also include: inspection of areas within AOIs to determine the effectiveness of the UXO/OE response action alternative implemented. During the periodic inspections, changes in the land uses will be assessed. The visual inspections will occur yearly for the first five years after the selected UXO/OE response action has been completed. After five years, the inspections will continue at a five-year frequency beginning at the end of the first five-year duration and continuing every five years up to 25 years from the completion of UXO/OE response action. If the results of these inspections indicate that the conditions of the AOI have changed significantly, additional actions may be taken to address the public safety associated with the presence of residual UXO/OE. Chapter 10 of this document provides additional details regarding the recurring review process.

7.3.1.3 Each of the four UXO/OE response action alternatives listed above was developed for each of the nine AOIs within the former Camp Butner Site investigated in this EE/CA. This approach has been taken to ensure that a tailored UXO/OE response

action alternative suitable for each AOI was developed based on the identified receptors and varying results of the UXO/OE investigation.

7.3.2 Alternative 1: No DoD Action Indicated

Alternative 1 is for the government to take no action in regards to locating, removing, and disposing of any potential UXO/OE present within a specific AOI at the former Camp Butner Site. The NDAI alternative assumes continued use of the AOI in its present state. If the potential exposure and hazards associated with the AOI are compatible with current and future development in the area as well as the UXO/OE response action objectives, then NDAI may be warranted. Revised Area 5 (comprised of former Area 5 plus most of former Area 1 and all of former Area 2 and former Area 3, as described in Subchapter 3.5.8) is a candidate for NDAI consideration since no UXO/OE was recovered in this AOI during the EE/CA or other prior investigations. It is important to note that the government will respond to any future UXO discovery within the former Camp Butner Site regardless of whether the affected parcel was designated for NDAI. Since either UXO or ordnance-related items were present in all other areas of the site, development of UXO/OE response action alternatives are warranted.

7.3.3 Alternative 2: Institutional Controls

7.3.3.1 Alternative 2, Institutional Controls, would provide a means for the DoD and their representatives to reduce UXO/OE exposure risk to the public through behavior modification resulting from public awareness programs and administrative restrictions, as summarized in Chapter 5 and Appendix F of this report. The IC alternative can be used in combination with other UXO/OE response actions or in cases where it may not be possible or practical to physically clear UXO/OE from the AOI. Successful implementation of IC is contingent on the cooperation and active participation of the existing powers and authorities of other government agencies to protect the public from UXO/OE risks.

7.3.3.2 IC strategies such as access control, public awareness programs, or a combination of strategies can be used to complement UXO/OE response actions and manage risk. It is important to understand that the UXO/OE risk is associated with three causative factors that, if any of these three factors is completely avoided, would prevent an UXO/OE-related accident. These three factors are: presence, access, and behavior. If there is no presence of ordnance within the AOI, then there is no possibility of an UXO/OE-related accident. If ordnance exists within the AOI, but people do not have access, then there will be no UXO/OE accident. Even if ordnance exists within the AOI and people have access to the ordnance, if their behavior is appropriate, then there will be no UXO/OE accident. An accident requires all three events or circumstances to be present. No UXO/OE accident can happen if any one causative factor is missing. Each factor provides the basis for a separate implementation strategy.

7.3.3.3 Behavior modification is an IC that relies on the personal responsibility of the property user. Even if the UXO/OE exists and there is open access to it, there is minimal risk if suitable behavior is observed. Appropriate behavior requires an

understanding of the situation and voluntary reaction in a responsible manner. Aside from development in the Town of Butner, land use within the former Camp Butner Site is typified by agriculture and forestland. Much of this land, both private and state owned, is included in the managed State Game Lands system and is used by hunters. Mechanisms may be implemented that modify the behavior of hunters; however, enforcement may present a challenge. The power of the federal government is limited in any situation where local enforcement is available. Therefore, the local authorities must be convinced that the risks are sufficient to warrant their participation. The concept of behavior modification through public awareness extends to agencies that have jurisdiction over the property within the former Camp Butner Site. Some behaviors that must be modified may belong to the local government. The full Institutional Analysis Plan for the former Camp Butner Site is provided in Appendix F.

7.3.4 Alternative 3: Surface Clearance of UXO/OE

7.3.4.1 Alternative 3 entails implementation of a surface clearance of UXO/OE. Surface clearance would be completed by experienced UXO-qualified personnel who would visually search the ground surface for any UXO/OE. In addition, UXO-qualified personnel would also use metal detection devices for screening to ensure that any UXO/OE items that may be present under the existing ground cover (leaves and vegetation) are located during the sweep. The UXO-qualified personnel would perform the sweep in fixed width intervals depending on the sweep reach of the type of metal detection equipment used, to ensure complete surface coverage. All metallic contacts on the ground surface would then be visually identified.

7.3.4.2 Any UXO/OE located during the sweep would be inspected to ensure its stability. During this inspection, a determination would be made whether the uncovered UXO/OE item could be moved. If a determination is made that the item is UXO, then it would be destroyed in place. Otherwise, removal of the item to a remote location for onsite destruction and disposal may be considered. If necessary, engineering controls would be used to minimize the need for evacuation of the public. All inert ordnance-related scrap would be removed from the area and transported offsite for disposal.

7.3.5 Alternative 4: Clearance of UXO/OE to Depth

7.3.5.1 Alternative 4 includes clearance of UXO/OE to depth. The removal depth is AOI-specific and defined based on consideration of the depths of the EE/CA findings, types of ordnance found and associated known maximum penetration depth, frost heave (4 inches, see Subchapter 2.2.3), and the current and future land use. This alternative would be implemented in one of two scenarios. One scenario would include the surface clearance of UXO/OE as described in Subchapter 7.3.4 but inclusive of real-time “mag and dig” excavation of subsurface anomalies (to a predetermined maximum depth) otherwise excluded from the surface clearance option. The second scenario would utilize DGM of the entire site followed by intrusive investigation of selected anomalies. In this manner the excavation activities would focus only on those anomalies displaying characteristics of suspect ordnance in an effort to reduce excavation of smaller inert metallic debris that could otherwise not have been discriminated in Scenario 1 above.

Similar to Scenario 1 the maximum excavation depth would be determined by AOI-specific considerations.

7.3.5.2 For implementation of this alternative, land surveying and brush clearing operations would be necessary. A professional land surveyor (aided by a UXO-qualified individual performing visual UXO/OE avoidance) would establish control points for the areas that require clearance, as well as establish a contiguous grid network system. Brush clearing crews would clear enough undergrowth so that the UXO/OE clearance crews could adequately perform their work. Geophysical instruments would be used to conduct the subsurface survey whether real-time "mag and dig" or DGM is implemented.

7.3.5.3 This alternative includes the intrusive investigation of surface and subsurface metallic anomalies identified during the metal detection survey to determine their exact nature. Engineering controls may have to be used to decrease the evacuation distance that would be required during the conduct of these investigations. Evacuation distances are determined by USAESCH based on the Most Probable Munition (MPM**)** or worst-case scenario for the potential detonation of an ordnance item that could be found at the site (or within the AOI). All non-essential personnel are evacuated based on this distance to maximize the safety of the operation. During the intrusive investigation, each selected anomaly is excavated until the source of the geophysical instrument reading is identified or until a predetermined clearance depth has been reached. Once the UXO/OE item is identified, the MSD may be adjusted accordingly for demolition operations.

7.4 INTRODUCTION OF SCREENING CRITERIA

7.4.1 In the EE/CA process, the alternatives described above are analyzed and screened against the three general categories of effectiveness, implementability, and cost to ensure that they meet the minimum standards of the criteria within each category. This screening was performed for all four alternatives identified above for each AOI individually within the former Camp Butner Site. The three general categories are described below along with the specific evaluation criteria contained within each of the categories.

7.4.2 The effectiveness of an alternative refers to its ability to meet the clean-up objective within the scope of the UXO/OE response action. The effectiveness category is divided into four evaluation criteria. These include Overall Protection of Public Safety and the Human Environment; Compliance with ARARs (Table 7.1); Long-Term Effectiveness; and Short-Term Effectiveness.

7.4.3 The implementability category includes the technical and administrative feasibility of implementing an alternative, the availability of various services and materials required during its implementation, and the acceptance of local residents and agencies. The implementability category is divided into six evaluation criteria including: Technical Feasibility; Administrative Feasibility; Availability of Services and Materials; Property Owner Acceptance; Local Agency Acceptance; and Community Acceptance.

7.4.4 Finally, each alternative is evaluated to estimate the overall implementation cost. Included in the cost calculation is an estimate as to the amount of time that will be necessary to complete the proposed alternative. Each of the evaluation criteria introduced above will be discussed in greater detail in the following paragraphs.

7.4.1 Effectiveness

7.4.1.1 **Overall Protection of Public Safety and the Human Environment:** Alternatives are evaluated under this criterion on how well they achieve and maintain protection of public safety and the human environment. A qualitative risk assessment process known as OE RIA is applied in evaluating this criterion, as described in Chapter 4. At this stage of the EE/CA, the OE RIA analysis consists of a qualitative evaluation of whether the alternative will have an impact on the potential for harm and the level of protectiveness at the AOI if the alternative is implemented, as compared to the existing or baseline condition. The evaluation is based on the ten factors used in the OE RIA presented in Chapter 4. Tables 7.2 through 7.10 present the evaluation of the OE RIA risk factors at each AOI for the four alternatives identified.

7.4.1.2 **Compliance with ARARs:** Evaluation under this criterion ensures that all requirements can be met without regulatory problems. The assessment may also include the to-be-considered (TBC) criteria. The applications of ARARs for each alternative will primarily focus on what ARARs apply as well as how they will be met.

7.4.1.3 Section 121(d)(1) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), requires that remedial actions must attain a degree of cleanup that assures protection of human health and the environment. Moreover, all potential ARARs must be outlined. ARARs include federal standards, requirements, criteria, and limitations under state environmental or facility siting regulations that are more stringent than federal standards.

7.4.1.4 Although the requirements of CERCLA Section 121 generally apply as a matter of law only to remedial actions, USEPA's policy for response actions is that ARARs will be identified and attained to the extent practicable. Three factors were

applied to determine whether identifying and attaining ARARs at the former Camp Butner Site was practical in a particular removal situation. These factors included:

- The exigencies of the situation;
- The scope of the potential UXO/OE response action to be taken; and
- The effect of ARAR attainment on the statutory limits for potential response action duration and cost.

7.4.1.5 ARARs were identified on a site-specific basis and involved a two-part analysis: first, a determination was made whether a given requirement was applicable; then if it was not applicable, a determination was made of whether it was nevertheless both relevant and appropriate. When this analysis resulted in a determination that a requirement was both relevant and appropriate, such a requirement was complied with to the same degree as if it were applicable.

7.4.1.6 "Applicable" requirements are those cleanup standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a remedial action site. "Relevant and appropriate" requirements are cleanup standards and control standards, and the substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to ordnance, a remedial action, the location, or other circumstance at a remedial action site, address problems or situations sufficiently similar to those encountered at a site to where their use is well-suited.

7.4.1.7 Three categories of ARARs have generally been used in ordnance projects: chemical-specific, location-specific, and action-specific. According to the NCP, chemical-specific ARARs are usually health or risk-based numerical values that establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Location-specific ARARs generally are restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations. Some examples of special locations include flood plains, wetlands, historic places, and sensitive ecosystems or habitats. Action-specific ARARs are usually technology or activity-based requirements or limitations placed on actions taken with respect to hazardous wastes, or requirements to conduct certain actions to address particular circumstances at a site. Table 7.1 summarizes the ARARs identified for the former Camp Butner Site.

7.4.1.8 Non-promulgated advisories or guidance documents issued by federal or state governments do not have the status of potential ARARs. However, these TBC criteria may be used in determining the necessary level of cleanup for protection of public safety and the human environment. Potential ARARs and TBCs for each of the three categories (i.e., chemical-specific, location-specific, and action-specific) are listed in Table 7.1 and discussed in the following paragraphs.

7.4.1.9 No chemical-specific ARARs or TBCs were identified for the potential UXO/OE response actions that may be applicable at the former Camp Butner Site. Removal of UXO is the primary concern of this EE/CA and not residual contamination that may have occurred due to ordnance burial, detonation, or disposal. After selected UXO/OE response actions are implemented, an evaluation of potential chemical contamination, if warranted, will be conducted as part of an environmental investigation.

7.4.1.10 The EE/CA investigation at the former Camp Butner Site has been managed pursuant to CERCLA and the NCP. The NCP regulations require that all removal actions or investigations on the site comply with the substantive requirements of federal, state, and local regulations. However, administrative permitting procedures are not required.

7.4.1.11 There are five potential location-specific ARARs that have been identified for review prior to implementation of an UXO/OE response action at an AOI within the former Camp Butner Site. These include the National Historic Preservation Act (NHPA), Protection of Wetlands, Endangered Species Act (ESA), Protection of Archaeological Resources, and Preservation of American Antiquities.

7.4.1.12 The ASR indicated archaeological findings from all eras of the regional prehistoric-early historic period in the piedmont (USACE, 1997). Prior coordination with the North Carolina State Historic Preservation Office has been conducted by CESAW and Parsons to ensure compliance with all relevant state and/or local historic preservation legislation. Through the process, no significant resources were identified.

7.4.1.13 Current information regarding endangered, threatened, and protected species was compiled for Durham, Granville, and Person counties using the U.S. Fish and Wildlife Service ESA List (updated 02/18/2003) and the North Carolina Natural Heritage Program (NCNHP), Divisions of Parks and Recreation, Department of Environmental and Natural Resources List (updated May 2003). The information provided included ten vertebrate animal species (two bird, one reptile, four fish, and three amphibians) and nine invertebrate animal species that potentially occur in the local area. Federal and State agencies identified the following information concerning threatened and endangered species:

- The following species of vertebrates occur within Durham, 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*) – SC; Pinewoods shiner (*Lythrurus matutinus*) – FSC, SC; four-toed salamander (*Hemidactylium scutatum*) – SC; and the Neuse River waterdog (*Necturus lewisi*) - SC. The following species occur within Durham and Granville counties: Carolina darter (*Etheostoma collies lepidinion*) – FSC, SC and Timber Rattlesnake (*Crotalus horridus*) – SC. The following species occurs in

Durham county: Carolina madtom (*Noturus furiousus*) – SC. The following species occurs in Granville county: Loggerhead Shrike (*Lanius ludovicianus*) – SC. The following species occurs in Person county: mole salamander (*Ambystoma talpoideum*) – SC.

- 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*) occurring within Durham and Granville counties.

- 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 county. There are eight invertebrates (all mollusks) listed as endangered or threatened by the NCNHP PPCA within one or more of Granville, Durham, or Person counties. Additional information regarding the NCNHP listed threatened and endangered species can be found at the website http://www.nc-es.fws.gov/es/es.html.

7.4.1.14 The action-specific TBC, AR 385-64 requires that safety measures be taken for the handling of explosive ordnance. Moreover, DoD 6055.9-STD requires that specialized personnel be employed to detect, remove, and dispose of ordnance. This standard also defines safety precautions and procedures for detonation or disposal of ordnance. The TBCs and ARARs that define excavation, disposal, and transportation requirements of OE are summarized in Table 7.1.

7.4.1.15 **Long Term Effectiveness:** This criterion measures how an alternative maintains the protection of human health and the environment after the UXO/OE response action objective has been met. The long-term effectiveness focuses on:

- the permanence of the UXO/OE response action alternative;
- the magnitude of residual risk following completion of the UXO/OE response action; and
- the adequacy and reliability of controls, if any, used to manage the treated residuals or untreated wastes that remain at the site following the UXO/OE response action.

7.4.1.16 **Short-Term Effectiveness:** This criterion addresses the effects of an alternative during the implementation phase. Alternatives are evaluated for their effects on human health and the environment prior to the UXO/OE response action objectives being met. More specifically, each alternative will be examined for:

- protection of the community and workers during the UXO/OE response action;
- adverse impacts resulting from construction and implementation; and

- the time required to meet the UXO/OE response objectives.

7.4.2 Implementability

7.4.2.1 **Technical Feasibility:** This criterion evaluates the ease of implementing a specific alternative. The analysis of the technical feasibility for each course of action focuses on difficulties in:

- the operation and construction of the UXO/OE response action;
- the reliability of the UXO/OE response action in relation to implementation; and
- the need and ease of conducting future UXO/OE removal actions/requirements following the initial undertaking.

7.4.2.2 **Administrative Feasibility:** This criterion focuses on the planning for a course of action. The evaluation of this criterion considers difficulties in:

- obtaining permits applicable to a proposed alternative;
- coordinating services needed to carry out an alternative; and
- arranging the delivery of services in a timely manner.

7.4.2.3 **Availability of Services and Materials:** This criterion primarily deals with the availability of services needed to carry out an alternative. Two issues are of primary importance under this criterion:

- convenient delivery of services and materials; and
- availability and timeliness of the quantities needed to implement the UXO/OE response action.

7.4.2.4 **Property Owner Acceptance:** Each of the alternatives will have a varying degree of impact on the future use of the area. As a result, each alternative is rated based on the degree of acceptance expressed by the current property owner, as identified during the IA (Appendix F). The majority of the land at the former Camp Butner Site is privately owned, with the remainder owned by State and Federal agencies.

7.4.2.5 **Local Agency Acceptance:** Each alternative is rated based on the degree of acceptance expressed by local, county and state environmental government agencies towards the various alternatives examined in the analysis, as identified during the IA (Appendix F).

7.4.2.6 **Community Acceptance:** Each alternative is rated based on the degree of acceptance expressed by local community members toward each of the UXO/OE response actions that are being analyzed, as identified during the IA (Appendix F).

7.4.3 Cost

As the scope of work for each alternative is developed, a cost estimate is calculated for costs associated with the implementation of each response action alternative. These costs include the direct and indirect capital costs incurred in implementing the UXO/OE response action alternative. The cost estimates are presented in Chapter 8.

7.5 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 1A

Intrusive results from the EE/CA investigation of Area 1A identified two UXO items (Mk II hand grenade and M1 practice anti-tank landmine with spotting charge and fuze) recovered at depths of 1 inch and 10 inches, respectively. A total of five OE scrap items (all inert and expended M15 grenades) were recovered at depths ranging from ground surface to one inch. All other anomalies were encountered within one foot of ground surface with the majority at depths less than six inches bgs. A summary of the UXO items recovered during the EE/CA investigation for each AOI is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C. Detailed descriptions and photographs of ordnance items are presented in Appendix E.

7.5.1 Alternative 1: No DoD Action Indicated

7.5.1.1 Effectiveness

During the EE/CA investigation, two UXO items were recovered from Area 1A. The NDAI alternative does not have an impact on the overall protection of public safety and the human environment at any of these areas (see Table 7.2). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.5.2 Alternative 2: Institutional Controls

7.5.2.1 Effectiveness

7.5.2.1.1 The exposure risks associated with the site-specific IC alternative (those IC components over and above the site-wide IC) is assumed to be the same as for the NDAI alternative because ordnance will not be removed. It should be noted; however, that a reduction in the number of exposures (although unquantifiable) will result from the site-specific IC (fencing) for this area. The short-term and long-term effectiveness criteria are met in this alternative for the area discussed in this chapter, although the risk is not quantifiably reduced (see Table 7.2). It is important to note that the government will respond to any future UXO discovery that may occur within Area 1A.

7.5.2.1.2 The following ***site-wide*** ICs were recommended in Subchapter 5.3 for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.5.2.1.3 In addition to site-wide ICs, a site-specific IC (fencing) is applicable in Area 1A due to the relatively localized extent of UXO/OE present and limited acreage of the site (approximately 20 acres). This IC will require the construction of a boundary fence that will encompass the entire area in order to restrict public access to this property permanently or until a clearance action has occurred.

7.5.2.2 Implementability

Implementation of the site-wide and site-specific ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.5.2.3 Cost

The estimated cost for construction of a perimeter fence to prohibit public access is $30,400 – $38,000. This cost is based on installation of approximately 3,800 linear feet (20 acres) of standard eight-foot chain-link fence, inclusive of two access gates. The cost to perform site-wide IC is presented in Subchapter 8.4.

7.5.3 Alternative 3: Surface Clearance of UXO/OE

7.5.3.1 Effectiveness

7.5.3.1.1 Two UXO findings were made during the EE/CA investigation in Area 1A, neither of which was located on the ground surface. Of the 7 OE scrap items recovered from the 98 anomalies intrusively investigated within this AOI only one (expended M15 smoke grenade) was located on the ground surface. However, all UXO and OE scrap items were recovered from depths 10 inches or less bgs. Completion of the Surface Clearance alternative for Area 1A will not provide significant protection to public safety and the human environment since the site conditions (minimal understory and eroded washes) suggest any surface residual UXO or OE scrap would likely have been picked up over the last 60 years. The short-term and long-term effectiveness criteria are also not met in this alternative for the area (see Table 7.2).

7.5.3.1.2 As described in Subchapter 3.5.1, Area 1A was designated as a flamethrower training range. Its proximity to the main base camp precludes the range from being utilized as an impact range. Frequently training ranges served dual purposes. Based on the intrusive findings from Area 1A, the most commonly found ordnance type was a hand grenade, which typically is hand thrown and not expected to penetrate significantly beyond the ground surface. Similarly, the second UXO item (M1 practice landmine with spotting charge and fuze) was recovered relatively shallow at 10 inches bgs. However, in light of intrusive findings, the likelihood of residual (practice landmines and grenades) UXO deeper than ground surface is anticipated. Therefore, this alternative would not be effective long-term because it would not permanently remove the majority of the residual UXO/OE suspected at the AOI. Therefore, further analysis of this alternative will not be performed (Table 7.2).

7.5.4 Alternative 4: Clearance of UXO/OE to Depth

7.5.4.1 Effectiveness

7.5.4.1.1 Two UXO findings were made during the EE/CA investigation in Area 1A, neither of which was located on the ground surface. Of the five OE scrap items recovered from the 98 anomalies intrusively investigated within this AOI only one (expended M15 smoke grenade) was located on the ground surface. However, all UXO and OE scrap items were recovered from depths 10 inches or less bgs. Completion of the Subsurface Clearance alternative (to a depth of one foot bgs) for Area 1A will provide significant protection to public safety and the human environment based on the vertical distribution of UXO and OE scrap identified during the EE/CA. The short-term and long-term effectiveness criteria are also met in this alternative for the area (see Table 7.2).

7.5.4.1.2 As described in Subchapter 3.5.1, Area 1A was designated as a flamethrower training range. Its proximity to the main base camp precludes the range from being utilized as an impact range. Frequently training ranges served dual purposes. Based on the intrusive findings from Area 1A, the most commonly found ordnance type was a hand grenade, which typically is hand thrown and not expected to penetrate beyond ground surface. Similarly, the second UXO item (M1 practice landmine with spotting charge and fuze) was recovered relatively shallow at 10 inches bgs. However, in light of intrusive findings, the likelihood of residual (practice landmines and grenades) UXO deeper than ground surface is anticipated. Therefore, this alternative would be effective long-term because it would permanently remove the majority of the residual UXO/OE suspected at the AOI.

7.5.4.2 Implementability

This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. The alternative would be implemented as described in Subchapter 7.3.5 for Scenario 1 (“mag and dig” technique). Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. In addition, Area 1A is entirely owned by the State of North Carolina and other government agencies. Input received from these stakeholders as a part of the public response period for this EE/CA report was incorporated into this final report.

7.5.4.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.6 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 4A

Intrusive results from the EE/CA investigation of Area 4A identified one UXO item (2.36-inch HE bazooka rocket) recovered at a depth of 3 inches. OE scrap items

excavated from this area consisted predominantly of remnants from 2.36-inch rockets, with one OE scrap item identified as an M9 rifle grenade fragment. A total of 20 OE scrap items were recovered from Area 4A at depths ranging from surface to 6 inches. A summary of the UXO/OE items recovered during the EE/CA investigation is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C.

7.6.1 Alternative 1: No DoD Action Indicated

7.6.1.1 Effectiveness

During the EE/CA investigation, UXO was recovered from Area 4A. The NDAI alternative does not have an impact on the overall protection of public safety and the human environment in this area (see Table 7.3). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.6.2 Alternative 2: Institutional Controls

7.6.2.1 Effectiveness

7.6.2.1.1 The exposure risks associated with the site-specific IC alternative (those IC components over and above the site-wide IC) is assumed to be the same as for the NDAI alternative because ordnance will not be removed. However, although unquantifiable, some reduction in the number of exposures will result. For Area 4A, no site-specific IC components were identified as viable. The short-term and long-term effectiveness criteria for site-wide IC are met in this alternative, although the risk is not reduced (see Table 7.3). It is important to note that the government will respond to any future UXO discovery that may occur in Area 4A.

7.6.2.1.2 The following ***site-wide*** ICs were recommended in Chapter 5.3 for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.6.2.2 Implementability

Implementation of the site-wide ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.6.2.3 Cost

The cost to perform this alternative is presented in Subchapter 8.4.

7.6.3 Alternative 3: Surface Clearance of UXO/OE

7.6.3.1 Effectiveness

7.6.3.1.1 Completion of the Surface Clearance alternative for Area 4A would likely provide some protection to public safety and the human environment. The short-term and long-term effectiveness criteria are also met in this alternative (see Table 7.3). A surface

clearance of 34 acres would be conducted by qualified UXO clearance personnel, as described in Subchapter 7.3.4. Overall results from the EE/CA investigation identified no surface UXO but numerous surface OE scrap was present. The recovered UXO item and all OE scrap items were all encountered within 6 inches of ground surface.

7.6.3.1.2 Based on the vertical extent of UXO and OE scrap recovered during this EE/CA investigation, this alternative would be effective long-term because it permanently removes a portion of the residual UXO/OE suspected at this AOI. However, no clearance can ever assure complete removal of all UXO/OE with the current level of available technology and the EE/CA findings suggest UXO is likely present in the subsurface. In consideration of future land use plans (residential development) in Area 4A, this alternative would provide some increased overall protection of public safety and the human environment. Thus, the Surface Clearance alternative meets the criteria in the Effectiveness category and further analysis will be performed.

7.6.3.2 Implementability

This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. The alternative will be implemented as described in Subchapter 7.3.4. Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. Area 4A was owned by a single private landowner but has recently been parceled and sold to additional private owners for new residential construction. Input received from these stakeholders as a part of the public response period for this EE/CA report was incorporated into this final report.

7.6.3.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.6.4 Alternative 4: Clearance of UXO/OE to Depth

7.6.4.1 Effectiveness

7.6.4.1.1 Completion of the Subsurface Clearance alternative for Area 4A would likely provide significant protection to public safety and the human environment. The short-term and long-term effectiveness criteria are also met in this alternative (see Table 7.3). There is a high likelihood that UXO/OE items are present in the subsurface based on the depths of recovery of UXO and OE scrap items during the EE/CA in Area 4A. A subsurface clearance of 34 acres would be conducted by qualified UXO clearance personnel, as described in Subchapter 7.3.5 Overall results from the EE/CA investigation identified no surface UXO but numerous surface OE scrap was present. The recovered UXO item and all OE scrap items were all encountered within 6 inches of ground surface.

7.6.4.1.2 This alternative includes clearance to depth for a total of 34 acres. The clearance removal would be conducted for items identified between the surface and a predetermined depth influenced by the anticipated types of UXO (2.36-inch bazooka

rockets) and recovery depths of ordnance related items. The UXO recovered with the greatest potential for depth of penetration is the 2.36-inch bazooka rocket. Studies conducted at the Jefferson Proving Ground estimated the maximum penetration depth for a 2.36-inch rocket at six inches. Based on this information, and considering the EE/CA findings and impending residential development, a clearance depth of 12 inches bgs would be effective in mitigating the majority of the explosive safety hazard. Therefore, this alternative would provide significant protection to public safety and the human environment. In addition, considering the imminent residential development, UXO construction support is warranted and should be provided to the property owners at their request (provided funds are available). As a result, the Clearance to Depth alternative does satisfy the Effectiveness category and further analysis of this alternative will be performed.

7.6.4.2 Implementability

This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. Implementation of this alternative is preferred using the technique described in Subchapter 7.3.5 for Scenario 2 (DGM followed by anomaly selection technique) because of the relatively level terrain and single anticipated UXO type. In this manner the excavation activities would focus only on those anomalies displaying characteristics of suspect ordnance (2.36-inch bazooka rocket) in an effort to reduce excavation of smaller inert metallic debris that could otherwise not have been discriminated in Scenario 1 ("mag and dig" technique). Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. Area 4A is entirely owned by private landowners. Input received from these stakeholders as a part of the public response period for this EE/CA report was incorporated into this final report.

7.6.4.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.7 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 4B

Intrusive results from the EE/CA investigation of Area 4B identified one UXO item (2.36-inch HE bazooka rocket) recovered from a depth of 18 inches. Four OE scrap items identified as undistinguishable HE projectile fragments were excavated at depths between 2 inches and 6 inches bgs. A summary of the UXO/OE items recovered during the EE/CA investigation for Area 4B is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C.

7.7.1 Alternative 1: No DoD Action Indicated

7.7.1.1 Effectiveness

During the EE/CA investigation, one UXO item was recovered from Area 4B. The NDAI alternative does not have an impact on the overall protection of public safety and the human environment in this area (Table 7.4). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.7.2 Alternative 2: Institutional Controls

7.7.2.1 Effectiveness

7.7.2.1.1 The exposure risks associated with the site-specific IC alternative (those IC components over and above the site-wide IC) is assumed to be the same as for the NDAI alternative because ordnance will not be removed. However, although unquantifiable, some reduction in the number of exposures will result. The short-term and long-term effectiveness criteria are met in this alternative for Area 4B, although the risk is not reduced (Table 7.4). It is important to note that the government will respond to any future UXO discovery within Area 4B.

7.7.2.1.2 The following ***site-wide*** ICs were recommended in Subchapter 5.3 for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.7.2.2 Implementability

Implementation of the site-wide ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.7.2.3 Cost

The cost to perform this alternative is presented in Subchapter 8.4.

7.7.3 Alternative 3: Surface Clearance of UXO/OE

7.7.3.1 Effectiveness

One UXO finding (2.36-inch HE bazooka rocket) was made during the EE/CA investigation in Area 4B at a depth of 18 inches bgs. Similarly, OE scrap items were also identified in the subsurface. Of the four OE scrap items recovered from the 42 anomalies intrusively investigated within this AOI none were located on the ground surface. However, all UXO and OE scrap items were recovered from depths of 18 inches or less bgs. Unlike Area 4A, completion of the Surface Clearance alternative for Area 4B will not provide additional protection to public safety and the human environment since the AOI conditions (regularly tilled agricultural land) suggest any surface residual UXO or OE scrap would likely have been previously encountered over the last 60 years. The short-term and long-term effectiveness criteria are also not met in this alternative for the

area (see Table 7.4). Therefore, this alternative would not be effective long-term because it would not permanently remove the residual UXO/OE suspected at the AOI. Therefore, further analysis of this alternative will not be performed (Table 7.4).

7.7.4 Alternative 4: Clearance of UXO/OE to Depth

7.7.4.1 Effectiveness

7.7.4.1.1 The Clearance to Depth alternative for Area 4B will provide the level of removal for this AOI to achieve significant protection to public safety and the human environment. The short-term and long-term effectiveness criteria are met in this alternative (Table 7.4). The UXO item found was recovered at a depth of 18 inches bgs.

7.7.4.1.2 This alternative includes clearance to depth for a total of 10 of the 20 acres within the AOI which is regularly farmed. The balance of the property supports two residential dwellings and forest. The primary property owner has indicated that there are no plans for expanding the agricultural portion of his property nor the residence.

7.7.4.1.3 The subsurface clearance (within the 10 acres) would be conducted for items identified between the surface and a predetermined depth influenced by the type of UXO and recovery depths of ordnance related items. In Area 4B, the UXO recovered was identified as a 2.36-inch rocket, and would not typically be expected to penetrate to the depth at which it was recovered (Jefferson Proving Ground). Taking into account the type and the recovery depths (6 inches or less) of the OE scrap items found at this AOI, residual UXO at depths of 18 inches would appear atypical. In determining the depth of clearance, intrusive farming practices were assessed. In particular, the invasive process of soil tilling which is penetrative to the depth of the tiller tines. The primary property owner indicated that for this AOI, tilling is known to penetrate 10 inches bgs. Therefore a clearance depth of 18 inches will effectively mitigate the exposure pathway most likely to be encountered by tilling associated with the current and future anticipated land use. This alternative will provide significant protection to public safety and the human environment. As a result, the Clearance to Depth alternative does satisfy the Effectiveness category and further analysis of this alternative will be performed.

7.7.4.2 Implementability

This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. Implementation of this alternative is preferred using the technique described in Subchapter 7.3.5 for Scenario 2 (DGM followed by anomaly selection technique) because of the relatively level terrain and single anticipated UXO type. In this manner the excavation activities would focus only on those anomalies displaying characteristics of suspect ordnance (2.36-inch bazooka rocket) in an effort to reduce excavation of smaller inert metallic debris that could otherwise not have been discriminated in Scenario 1 ("mag and dig" technique). Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. Area 4B is entirely owned by two private landowners. Input received

from the property owners as a part of the public response period for this EE/CA report was incorporated into this final report.

7.7.4.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.8 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 4C

Intrusive results from the EE/CA investigation of Area 4C identified one UXO item as an unfuzed 105mm HE projectile recovered from 3 inches bgs. A total of 313 OE scrap items were recovered from depths ranging from 1 inch to 30 inches bgs. A large amount (approximately 259 lbs) of the OE scrap was identified as heavy artillery HE fragments. A summary of the UXO/OE items recovered during the EE/CA investigation is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C.

7.8.1 Alternative 1: No DoD Action Indicated

7.8.1.1 Effectiveness

During the EE/CA investigation, one UXO item was recovered (unfuzed 105mm HE projectile) from Area 4C. The NDAI alternative does not have an impact on the overall protection of public safety and the human environment in this area (Table 7.5). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.8.2 Alternative 2: Institutional Controls

7.8.2.1 Effectiveness

7.8.2.1.1 The exposure risks associated with the site-specific IC alternative (those IC components over and above the site-wide IC) is assumed to be the same as for the NDAI alternative because ordnance will not be removed. However, although unquantifiable, some reduction in the number of exposures will result. The short-term and long-term effectiveness criteria are met in this alternative for the area discussed in this chapter, although the risk is not reduced (Table 7.5). It is important to note that the government will respond to any future UXO discovery within Area 4C.

7.8.2.1.2 The following ***site-wide*** ICs were recommended in Subchapter 5.3 for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.8.2.2 Implementability

Implementation of the site-wide ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.8.2.3 Cost

The cost to perform this alternative is presented in Subchapter 8.4.

7.8.3 Alternative 3: Surface Clearance of UXO/OE

7.8.3.1 Effectiveness

One UXO finding was made during the EE/CA investigation in Area 4C at a depth of 3 inches bgs. Of the 313 OE scrap items recovered from the 442 anomalies intrusively investigated within this 126-acre AOI, approximately 25% were on the surface. During the EE/CA investigation, OE scrap items were recovered from depths up to 30 inches; indicative of the potential presence of UXO at similar depths. Completion of the Surface Clearance alternative for Area 4C would provide minimal additional protection to public safety and the human environment. The short-term and long-term effectiveness criteria are also met (Table 7.5). As described in Subchapter 3.5.5, Area 4C lies within the primary impact/target area (inclusive of the Mock German Village target) for several former ranges utilizing heavy artillery. These type projectiles tend to have significant penetration depths and are not frequently present on the ground surface. A surface clearance of the entire 126 acres comprising Area 4C would do little, if anything, to reduce the presence of residual UXO within the AOI. Therefore, further analysis of this alternative will not be performed (Table 7.5).

7.8.4 Alternative 4: Clearance of UXO/OE to Depth

7.8.4.1 Effectiveness

7.8.4.1.1 The Clearance to Depth alternative for Area 4C will provide the level of removal for this AOI to achieve significant protection to public safety and the human environment. The short-term and long-term effectiveness criteria are met in this alternative (Table 7.5). The likelihood exists that subsurface UXO/OE items are present based on the type and depths of UXO and OE scrap items recovered during the EE/CA and recovered by one of the property owners in Area 4C. Two projectiles (one 105mm and one 155mm) were reported to local authorities during the time of the EE/CA investigation (Subchapter 3.5.5).

7.8.4.1.2 Due to the existence of 8 residential dwellings and potential for future residential development in the southern portion of Area 4C (30 acres), the most effective alternative that would significantly reduce the exposure pathway is the Clearance to Depth. The clearance removal would be conducted for items identified between the surface and a predetermined depth influenced by the type of UXO and recovery depths of ordnance related items. The UXO recovered with the greatest potential for depth of penetration is the 155mm projectile. Based on the deepest penetrating ordnance type and taking into account the recovery depths of UXO and OE scrap, a clearance depth of 48

inches would effectively mitigate the explosive safety hazard. This approach would involve an initial surface clearance in an effort to mitigate surface debris, which will then be followed by DGM survey coverage (Subchapter 7.3.5, Scenario 2). The digital geophysical data will then be analyzed and evaluated, and suspect anomalies will be intrusively investigated down to 48 inches bgs. Therefore this alternative will provide significant protection to public safety and the human environment. In addition, considering the potential for additional residential development, UXO construction support is warranted and should be provided to the property owners at their request (provided funds are available). As a result, the Clearance to Depth alternative does satisfy the Effectiveness category and further analysis of this alternative will be performed.

7.8.4.1.3 Subsurface removal action is not warranted for the undeveloped portions of the AOIs (approximately 96 acres) given the incomplete exposure pathway. If development of this area for additional residential use or for commercial logging becomes evident in the future, UXO support is recommended (if funds are available).

7.8.4.2 Implementability

7.8.4.2.1 This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. The alternative would be implemented as described in Subchapter 7.3.5 for Scenario 2 (DGM followed by anomaly selection technique). In this manner the excavation activities would focus only on those anomalies displaying characteristics of suspect ordnance (heavy artillery) in an effort to reduce excavation of smaller inert metallic debris that could otherwise not have been discriminated in Scenario 1 ("mag and dig" technique). In the interim, a TCRA is recommended for a portion of one of the residential properties within the AOI. This approximately 5-acre parcel contained the two HE projectile (105mm and 155mm) findings and the property owner has indicated plans for both a garden and construction of out buildings.

7.8.4.2.2 Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. Area 4C is owned by several private landowners. Input received from the property owners as a part of the public response period for this EE/CA report was incorporated into this final report.

7.8.4.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.9 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 4D

Intrusive results from the EE/CA investigation of Area 4D identified one UXO item as a 37mm projectile recovered at a depth of 2 inches bgs. A total of 27 OE scrap items were recovered from depths between surface and 10 inches. A summary of the UXO/OE

items recovered during the EE/CA investigation is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C.

7.9.1 Alternative 1: No DoD Action Indicated

7.9.1.1 Effectiveness

During the EE/CA investigation, one UXO item was recovered from within the 453 acres comprising Area 4D. The NDAI alternative does not have an impact on the overall protection of public safety and the human environment at this area (Table 7.6). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.9.2 Alternative 2: Institutional Controls

7.9.2.1 Effectiveness

7.9.2.1.1 The exposure risks associated with the site-specific IC alternative (those IC components over and above the site-wide IC) is assumed to be the same as for the NDAI alternative because ordnance will not be removed However, although unquantifiable, some reduction in the number of exposures will result. The short-term and long-term effectiveness criteria are met in this alternative for the area discussed in this chapter, although the risk is not reduced (Table 7.6). It is important to note that the government will respond to any future UXO discovery that may occur in Area 4D.

7.9.2.1.2 The following ***site-wide*** ICs were recommended in Chapter 5.3 for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.9.2.2 Implementability

Implementation of the site-wide ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.9.2.3 Cost

The cost to perform this alternative is presented in Subchapter 8.4.

7.9.3 Alternative 3: Surface Clearance of UXO/OE

7.9.3.1 Effectiveness

One UXO finding (37mm HE projectile) was made during the EE/CA investigation in Area 4D at a depth of 2 inches bgs. Similarly, OE scrap items were also identified in the subsurface. Of the 27 OE scrap items recovered from the 99 anomalies intrusively investigated within this AOI few were located on the ground surface. However, all UXO and OE scrap items were recovered from depths of 10 inches or less bgs. Completion of the Surface Clearance alternative for Area 4D will not provide additional protection to public safety and the human environment since the AOI conditions (combination of

regularly tilled agricultural and forested land) suggest any surface residual UXO or OE scrap would likely have been previously encountered over the last 60 years. During the EE/CA investigation, OE scrap item was recovered from depths up to 10 inches, which suggests there is a potential for residual UXO at similar depths. The short-term and long-term effectiveness criteria are also not met in this alternative for the area (see Table 7.6). Therefore, this alternative would not be effective long-term because it would not permanently remove the residual UXO/OE suspected at the AOI. Therefore, further analysis of this alternative will not be performed (Table 7.6).

7.9.4 Alternative 4: Clearance of UXO/OE to Depth

7.9.4.1 Effectiveness

7.9.4.1.1 The Clearance to Depth alternative for Area 4D will provide a level of removal for this AOI to achieve significant protection to public safety and the human environment. The short-term and long-term effectiveness criteria are met in this alternative (Table 7.6). There is a high likelihood that UXO/OE items are present in the subsurface based on the depths of recovery of UXO and OE scrap items during the EE/CA in Area 4D.

7.9.4.1.2 This alternative includes clearance to depth for a total of 453 acres. The clearance removal would be conducted for items identified between the surface and a predetermined depth influenced by the anticipated types of UXO (37mm-155mm projectiles) and recovery depths of ordnance related items. The UXO recovered with the greatest potential for depth of penetration is the 155mm projectile. Based on the ordnance type with the greatest penetration depth potential and taking into account the recovery depths of OE scrap, a clearance depth of 24 inches would be effective in mitigating the majority of the explosive safety hazard. Therefore this alternative will provide significant protection to public safety and the human environment. As a result, the Clearance to Depth alternative does satisfy the Effectiveness category and further analysis of this alternative will be performed.

7.9.4.2 Implementability

This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. The alternative would be implemented as described in Subchapter 7.3.5 for Scenario 1 (“mag and dig” technique). Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. Area 4D is entirely owned by private landowners. Input received from these stakeholders as a part of the public response period for this EE/CA report was incorporated into this final report.

7.9.4.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.10 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 4E

Intrusive results from the EE/CA investigation of Area 4E identified one 37mm projectile recovered at 1 inch bgs. The only OE scrap item found in this area was a single HE projectile fragment at a depth of one inch bgs. A summary of the UXO/OE items recovered during the EE/CA investigation is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C.

7.10.1 Alternative 1: No DoD Action Indicated

7.10.1.1 Effectiveness

During the EE/CA investigation, one UXO item was recovered from Area 4E. The NDAI alternative does not have an impact on the overall protection of public safety and the human environment of this area (Table 7.7). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.10.2 Alternative 2: Institutional Controls

7.10.2.1 Effectiveness

7.10.2.1.1 The exposure risks associated with the site-specific IC alternative (those IC components over and above the site-wide IC) is assumed to be the same as for the NDAI alternative because ordnance will not be removed. However, although unquantifiable, some reduction in the number of exposures will result. The short-term and long-term effectiveness criteria are met in this alternative for the area discussed in this chapter, although the risk is not reduced (Table 7.7). It is important to note that the government will respond to any future UXO discovery that may occur in Area 4E.

7.10.2.1.2 The following site-wide ICs were recommended in Chapter 5.3 for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.10.2.2 Implementability

Implementation of the site-wide ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.10.2.3 Cost

The cost to perform this alternative is presented in Subchapter 8.4.

7.10.3 Alternative 3: Surface Clearance of UXO/OE

7.10.3.1 Effectiveness

Area 4E is generally utilized for tobacco production. One UXO finding (37mm HE projectile) was made during the EE/CA investigation in Area 4E at a depth of 1 inch bgs.

Similarly, only one OE scrap item was identified, also at a depth of 1 inch bgs. Completion of the Surface Clearance alternative for Area 4E will not provide additional protection to public safety and the human environment since the AOI conditions (combination of regularly tilled agricultural and forested land) suggest any surface residual UXO or OE scrap would likely have been previously encountered over the last 60 years. The short-term and long-term effectiveness criteria are also not met in this alternative for the area (see Table 7.7). Therefore, this alternative would not be effective long-term because it would not permanently remove the residual UXO/OE suspected at the AOI. Therefore, further analysis of this alternative will not be performed (Table 7.7).

7.10.4 Alternative 4: Clearance of UXO/OE to Depth

7.10.4.1 Effectiveness

Only one UXO and one OE scrap item were recovered (both at 1 inch bgs) from within the 3 grids investigated during the EE/CA. Two of the grids did not contain either UXO or OE scrap. Area 4E is located within the former 37mm range but does not extend significantly past the firing point. Therefore, it is unlikely that firing targets were present within Area 4E which is supported by the lack of ordnance-related findings. Approximately 70% of the AOI is utilized for tobacco production and has been for many years. This land use is expected to continue. The balance of the AOI is undeveloped woodlands with a total of one residential dwelling within the AOI. A clearance to predetermined depth is expected to have minimal impact on the presence of residual ordnance within the AOI (as the EE/CA results do not indicate any significant ordnance presence). In light of current farming practices and lack of ordnance presence, the Clearance to Depth alternative would not meet the short-term and long-term effectiveness criteria for this AOI. Therefore, further analysis of this alternative will not be performed (Table 7.7).

7.11 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 4

Five UXO items were discovered during the EE/CA investigation within the modified boundaries of Area 4 (105mm projectile, 57mm projectile, unfuzed 155mm shrapnel round, unfuzed 2.36-inch HE bazooka rocket warhead, and M series fuze). A total of 1118 OE scrap items (predominantly HE projectile fragments consistent with the AOI location within the impact ranges) were recovered in Area 4 with the majority found within 0 and 12 inches bgs. A summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C. A summary of the UXO/OE items recovered during the EE/CA investigation is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C.

7.11.1 Alternative 1: No DoD Action Indicated

There is considered to be a moderate likelihood of occurrence for UXO within Area 4 based on the presence of impact craters, historic firing fans, and ordnance scrap items recovered in the area. The NDAI alternative does not have an impact on the overall

protection of public safety and the human environment (Table 7.8). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.11.2 Alternative 2: Institutional Controls

7.11.2.1 Effectiveness

7.11.2.1.1 Intrusive findings indicate the potential for residual UXO/OE presence within Area 4. Based on this assumption, the exposure risks associated with the site-specific IC alternative (those IC components over and above the site-wide IC) are the same as for the NDAI alternative because no ordnance will be removed. However, although unquantifiable, some reduction in the number of exposures will result. The short-term and long-term effectiveness criteria are met in this alternative, although the risk is not reduced (Table 7.8). It is important to note that the government will respond to any future UXO discovery that may occur in Area 4.

7.11.2.1.2 The following ***site-wide*** ICs were recommended in Subchapter 5.3 for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.11.2.2 Implementability

Implementation of the ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.11.2.3 Cost

The cost to perform this alternative is presented in Chapter 8.4.

7.11.3 Alternative 3: Surface Clearance of UXO/OE

7.11.3.1 Effectiveness

7.11.3.1.1 Five UXO findings were made during the EE/CA investigation in Area 4, one of which (105mm HE projectile) was located on the surface. Of the 1118 OE scrap items recovered during the intrusive investigation within this AOI very few were on the surface. However, completion of the Surface Clearance alternative for Area 4 will provide some additional protection to public safety and the human environment. The short-term and long-term effectiveness criteria are also met (Table 7.8). As described in Subchapter 3.5.2, portions of Area 4 lies within the impact area for several former ranges and impact areas utilizing projectiles between 37mm and 155mm in size. These type projectiles tend to have significant penetration depths and are not frequently present on the ground surface. A surface clearance of the entire 21,139 acres comprising Area 4 would be conducted by qualified UXO clearance personnel, as described in Subchapter 7.3.4. Recovery of OE scrap items during the EE/CA investigation from depths of 24 inches bgs suggests there is a likelihood of residual UXO at similar depths. Therefore,

the Surface Clearance alternative will only mitigate the explosive safety hazard for Area 4.

7.11.3.1.2 Based on the vertical extent of UXO and OE scrap recovered during this EE/CA investigation, this alternative will be effective long-term because it should permanently remove a portion of the residual UXO/OE suspected at this AOI. However, no clearance can ever assure complete removal of all UXO/OE with the current level of available technology. In consideration of the residential component (>200 total dwellings) and public exposure due to various activities (hunting, hiking, child play, etc) in Area 4, this alternative will provide increased overall protection of public safety and the human environment. Thus, the Surface Clearance alternative meets the criteria in the Effectiveness category and further analysis will be performed.

7.11.3.2 Implementability

This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. The alternative will be implemented as described in Subchapter 7.3.4. Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. Area 4 is owned by private landowners. Input received from these stakeholders as a part of the public response period for this EE/CA report was incorporated into this final report.

7.11.3.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.11.4 Alternative 4: Clearance of UXO/OE to Depth

7.11.4.1 Effectiveness

7.11.4.1.1 The Clearance to Depth alternative for Area 4 will provide a level of removal for this AOI to achieve significant protection to public safety and the human environment. Three of the five UXO items found were recovered at depths less than 6 inches bgs (105mm projectile, 57mm projectile, and M series fuze). The two other UXO items were recovered from 10 inches bgs (2.36-inch bazooka rocket) and 30 inches bgs (155mm shrapnel projectile). The short-term and long-term effectiveness criteria are met in this alternative (Table 7.8). Further, there is a high likelihood that additional UXO/OE items are present in the subsurface based on the depths of recovery of UXO and OE scrap items during the EE/CA in Area 4.

7.11.4.1.2 This alternative includes clearance to depth for a total of 21,139 acres, much of which is regularly farmed. In addition, there are in excess of 200 residential dwellings. The clearance removal would be conducted for items identified between the surface and a predetermined depth influenced by the anticipated types of UXO (37mm-155mm projectiles) and recovery depths of ordnance related items. The types of UXO and OE scrap recovered confirm multiple use training ranges in this AOI. In addition, TEC interpretation of historical aerial photography indicates the presence of suspect

impact craters (USACE 2001a). The UXO recovered with the greatest potential for depth of penetration is the 105mm projectile. Based on the ordnance type with the greatest penetration depth potential and taking into account the recovery depths of OE scrap, a clearance depth of 24 inches would be effective in mitigating the majority of the explosive safety hazard. Residual UXO at depths of 30 inches bgs would appear ayptical.

7.11.4.1.3 In determining the depth of clearance, intrusive farming practices were assessed. In particular, the invasive process of soil tilling which is penetrative to the depth of the tiller tines. Tilling is known to penetrate 10 inches bgs based on discussions with local farmers. Therefore a clearance to a depth to one foot would effectively mitigate the exposure pathway most likely to be encountered by tilling (despite the fact the UXO would likely remain at greater depths). However, the anticipated cost impact to increase the effective clearance depth to 2 feet bgs is warranted (based on the residential component) and would provide additional protection in the event deeper intrusion occurs in the future. This alternative will provide significant protection to public safety and the human environment, given the current and future anticipated land use. Therefore this alternative will provide significant protection to public safety and the human environment. As a result, the Clearance to Depth alternative does satisfy the Effectiveness category and further analysis of this alternative will be performed.

7.11.4.2 Implementability

The alternative would be implemented as described in Subchapter 7.3.5 for a combination of Scenario 1 ("mag and dig") and Scenario 2 (DGM followed by anomaly selection technique). In this manner the excavation activities would focus only on those anomalies displaying characteristics of suspect ordnance (2.36-inch bazooka rocket and heavy artillery) for farming areas in an effort to reduce excavation of smaller inert metallic debris. For residential areas all anomalies would be intrusively investigated. Based on the large acreage encompassed by this AOI (approximately 21,139 acres) and open land, the most effective strategy is to utilize a towed-array during DGM survey to increase production. Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. Area 4D is owned by numerous private landowners. Input received from the property owners as a part of the public response period for this EE/CA report was incorporated into this final report.

7.11.4.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.12 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR AREA 5

No UXO items were discovered during the EE/CA investigation within the modified boundaries of Area 5. A total of 754 anomalies were intrusively investigated in Area 5, from which a single OE scrap item (pressure plate to M15 anti-tank mine) was recovered at ground surface.

7.12.1 Alternative 1: No DoD Action Indicated

7.12.1.1 Effectiveness

For Area 5, the NDAI alternative complies with ARARs since no UXO/OE items were recovered during the EE/CA investigation. Therefore, UXO/OE response action alternatives will not be further developed for these areas. The short-term and long-term effectiveness criteria are met in this alternative for both areas although the risk is not reduced (Table 7.9). It is important to note that the government will respond to any future UXO discovery within Area 5, regardless of whether the affected parcel was designated for NDAI.

7.12.1.2 Implementablility

The NDAI alternative is both technically and administratively feasible. No services or materials are necessary for implementation.

7.12.1.3 Cost

The NDAI alternative is a no-cost alternative. However, for all sectors a recurring review process will be implemented, as described in Chapter 10, to ensure the recommended alternative remains appropriate. The cost for the recurring review process will be developed as part of a Recurring Review Plan to be developed as part of a separate project after completion of the EE/CA process.

7.12.2 Alternative 2: Institutional Controls

7.12.2.1 Effectiveness

7.12.2.1.1 The exposure risks associated with the IC alternative (those IC components over and above the site-wide IC) are the same as for the NDAI alternative because no ordnance will be removed. However, no UXO/OE items were discovered during the EE/CA investigation Area 5.

7.12.2.1.2 Based on the intended future land use in Area 5 (agriculture, hunting, and residential development), no additional IC components (above the site-wide recommended components) were considered effective (see Table 7.9). As a result, neither the short-term nor long-term Effectiveness criteria are met in this alternative nor is the risk reduced. Thus, the IC alternative does not satisfy the Effectiveness criteria and further analysis of this alternative will not be performed.

7.12.3 Alternative 3: Surface Clearance of UXO/OE

7.12.3.1 Effectiveness

No UXO findings were made during the EE/CA investigation in Area 5. The single OE scrap item recovered from the 754 anomalies intrusively investigated within this AOI is an inexplicable outlier that does not merit a removal action in light of intrusive and archival evidence. Therefore, the finding does not indicate a public safety risk is present in Area 5 and implementation of a Surface Clearance alternative is not warranted, as it

would not meet the Effectiveness criteria. Therefore, further analysis of this alternative will not be performed (Table 7.9).

7.12.4 Alternative 4: Clearance of UXO/OE to Depth

7.12.4.1 Effectiveness

No UXO/OE items were recovered during the EE/CA investigation of Area 5. The findings do not indicate a public UXO/OE safety risk is present, implementation of a Clearance to Depth alternative is not warranted, as it would not meet the Effectiveness criteria. Therefore, further analysis of this alternative will not be performed (Table 7.9).

7.13 APPLICATION OF THE EVALUATION CRITERIA BY ALTERNATIVE FOR LAKEVIEW SUBDIVISION

Intrusive results from the EE/CA and TCRA investigation of the Lakeview Subdivision Site identified 7 UXO items (1 during EE/CA and 6 during TCRA) recovered at depths from 0 of 6 inches bgs. OE scrap items excavated from this area consisted of landmine elements, 2.36-inch bazooka rockets and parts, 60mm mortar, 75mm projectile, and rifle grenade components. A total of 81 OE scrap items were recovered from this AOI at depths ranging from surface to 6 inches bgs. A summary of the UXO/OE items recovered during the EE/CA and TCRA investigation is presented in Table 3.3 and a summary of the intrusive findings for the re-sectored AOIs is presented in Appendix C.

7.13.1 Alternative 1: No DoD Action Indicated

7.13.1.1 Effectiveness

During the EE/CA investigation, one UXO item (37mm HE projectile) was recovered from Lakeview Subdivision. In addition, several 2.36-inch bazooka rockets were discovered by one of the property owners. As a result, the TCRA was conducted during which another 6 UXO items were recovered. The NDAI alternative does not have an impact on the overall protection of public safety and the human environment in this area (Table 7.10). As this alternative fails the Effectiveness category, no further analysis of this alternative will be performed.

7.13.2 Alternative 2: Institutional Controls

7.13.2.1 Effectiveness

7.13.2.1.1 The exposure risks associated with the IC alternative (those IC components over and above the site-wide IC) is assumed to be the same as for the NDAI alternative because ordnance will not be removed. However, although unquantifiable, some reduction in the number of exposures will result. The short-term and long-term effectiveness criteria are met in this alternative for the area discussed in this chapter, although the risk is not reduced (Table 7.10). It is important to note that the government will respond to any future UXO discovery that may occur at this site.

7.13.2.1.2 The following ***sitewide*** ICs were recommended for AOIs with UXO present: Signage; land use restriction; notification during property transfer, during permitting, by tax bill, and during issuance of hunting permits; preparation and distribution of visual, audio, and printed media; classroom education; audio/visual media; creation of an internet website; establishment of an Ad Hoc committee; and reverse 911.

7.13.2.2 Implementability

Implementation of the site-wide ICs listed above are technically and administratively feasible and the services and materials necessary to implement such are readily available.

7.13.2.3 Cost

The cost to perform this alternative is presented in Chapter 8.4.

7.13.3 Alternative 3: Surface Clearance of UXO/OE

7.13.3.1 Effectiveness

Completion of the Surface Clearance alternative for the Lakeview Subdivision Site has already been conducted as part of the TCRA to provide immediate significant protection to public safety and the human environment. The short-term and long-term effectiveness criteria were met in this alternative (Table 7.10). A surface clearance of the 26-acre site was completed by qualified UXO clearance personnel to a depth of 6 inches, as described in Subchapter 7.3.4.

7.13.4 Alternative 4: Clearance of UXO/OE to Depth

7.13.4.1 Effectiveness

7.13.4.1.1 No UXO or OE scrap was recovered beyond a depth of 6 inches bgs in the Lakeview Subdivision, the maximum depth investigated during the TCRA. The DGM survey conducted after completion of the TCRA suggests that additional subsurface investigation is warranted (Appendix B). The USAESCH reviewed the DGM survey and had the following conclusions:

"The geophysical maps prepared subsequent to field activities confirm the presence of additional metallic debris concentrated within the immediate vicinity of the Cash Property with lesser amounts dispersed throughout the Lakeview Subdivision area. Review of the geophysical data collected, historical information, utility locations, surface feature maps, and the TCRA excavation results indicate the origin of recovered UXO, OE scrap, and non-OE scrap may be the result of periodic debris disposal in addition to fired projectiles". "The only way to confirm the remaining anomalies are not UXO is to conduct a clearance to depth removal action beginning in the northwest corner of the site in the immediate vicinity of the Cash Property and proceeding grid by grid towards the south and east until no additional UXO are recovered".

7.13.4.1.2 This alternative will provide significant protection to public safety and the human environment, given the current and future anticipated land use. As a result, the Clearance to Depth alternative does satisfy the Effectiveness category and further analysis of this alternative will be performed.

7.13.4.2 Implementability

This type of UXO/OE removal activity is both technically and administratively feasible and the services and materials necessary to implement such a removal are readily accessible. The alternative would be implemented as described in Subchapter 7.3.5 for Scenario 2 (DGM [already completed] followed by anomaly selection technique). In this manner the excavation activities would focus only on those anomalies displaying characteristics of suspect ordnance (2.36-inch bazooka rockets, grenades, 37mm HE projectiles) in an effort to reduce excavation of smaller inert metallic debris that could otherwise not have been discriminated in Scenario 1 ("mag and dig" technique). Generally, clearance alternatives are acceptable to local agencies, property owners and the local community as a means to reduce the residual UXO/OE risk. The Lakeview Subdivision is owned by several private landowners with portions of the buffer zone owned by the State of North Carolina. Input received from the property owners and the State as a part of the public response period for this EE/CA report was incorporated into this final report.

7.13.4.3 Cost

The cost to perform this alternative is presented in Chapter 8.

7.14 SUMMARY OF REMAINING UXO/OE RESPONSE ACTION ALTERNATIVES

The UXO/OE response action alternatives for the former Camp Butner Site that remained after the initial screening of the four response action alternatives against the three general categories of effectiveness, implementability, and cost include:

Alternative 1 – No DoD Action Indicated at Area 5;

Alternative 2 – Site-specific Institutional Controls at Area 1A; Site-wide for all others;

Alternative 3 – Surface Clearance of UXO/OE at Area 4A and Area 4

Alternative 4 – Clearance to Depth of UXO/OE at Area 1A, Area 4, Area 4A, Area 4B, Area 4C, Area 4D, and Lakeview Subdivision.

Table 7.1
Potential ARARs for UXO/OE Removal
Camp Butner, North Carolina

Activity	ARAR/TBC	Citation	Applicability or Relevance
Chemical-Specific			
None			
Location-Specific			
Location of an action within an area where it may cause irreparable harm, loss or destruction of significant artifacts or historic landmarks	National Historic Preservation Act	36 CFR Part 65, and 800	During removal action, any material that may be considered historical will be reported pursuant to requirements
	Protection of Wetlands	33 CFR 320 et. seq. Executive Order 11988	Requires action to be taken to minimize loss or degradation of wetlands.
	Endangered Species Act	16 USC δ 1531 et. Seq.	Requires that authorized actions do not jeopardize the continued existence of endangered or threatened species, or their habitats.
	Protection of Archaeological Resources	43 CFR Part 7 (also: 36 CFR Part 296, 32 CFR Part 229, and 18 CFR Part 1312 – same regulations)	Requires a permit to excavate, remove, or otherwise alter any archaeological resource
	Preservation of American Antiquities	43 CFR Part 3	Requires a permit for the examination of ruins, excavation of archaeological sites, and gathering of objects of antiquity
Action-Specific			

Table 7.1
Potential ARARs for UXO/OE Removal
Camp Butner, North Carolina

Activity	ARAR/TBC	Citation	Applicability or Relevance
Excavation	Department of Defense Ordnance Safety Standards	DoD 6055.9-STD	Requires specialized personnel be employed in the detection, removal, and disposal of UXO/OE.
Transportation	D.O.T. Hazardous Material Transportation Regulations	49 CFR 107, 171-177, 100-199	Regulates transportation of hazardous materials such as ordnance.
	E.P.A. Hazardous Materials Manifesting Requirements	40 CFR 262, 263	Manifesting for transportation of ordnance items may be required pursuant to RCRA.
Disposal	Disposal of Ordnance Items	40 CFR 264, Subpart X	Established ordnance disposal requirements.
	D.O.T. Hazardous Material Transportation Regulations	49 CFR 107, 171-177	Regulates transportation of hazardous materials such as ordnance.
Action-Specific			
Excavation	Department of Defense Ordnance Safety Standards	DoD 6055.9-STD	Requires specialized personnel be employed in the detection, removal, and disposal of UXO/OE.
Transportation	D.O.T. Hazardous Material Transportation Regulations	49 CFR 107, 171-177, 100-199	Regulates transportation of hazardous materials such as ordnance.
	E.P.A. Hazardous Materials Manifesting Requirements	40 CFR 262, 263	Manifesting for transportation of ordnance items may be required pursuant to RCRA.
Disposal	Disposal of Ordnance Items	40 CFR 264, Subpart X	Established ordnance disposal requirements.
	D.O.T. Hazardous Material Transportation Regulations	49 CFR 107, 171-177	Regulates transportation of hazardous materials such as ordnance.

TABLE 7.2
IMPACT ANALYSIS
Area 1A

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	***Area 1A*:** **EE/CA:** (1) M1 anti-tank practice mine w/fuze, **(1) Mk II hand grenade**	Less Sensitive	2 in 1.15 acres	Surface – 0 Subsurface – 2	No Restriction	Moderately Stable	Significant (Construction, trespass, hiking)	0 – 5 /0
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	**Impact**	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Clearance to Depth	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact

[1] Denotes items found during the EE/CA investigation, as indicated.

[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.3
IMPACT ANALYSIS
Area 4A

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	**EE/CA: (1) 2.36-inch HE bazooka rocket**	Less Sensitive	1 in 1.15 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Construction & child play)	5 – 10 /2
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact
Clearance to Depth	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact

[1] Denotes items found during the EE/CA, as indicated.

[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.4
IMPACT ANALYSIS
Area 4B

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	**EE/CA: (1) 2.36-inch HE bazooka rocket OTHER:** (1) 2.36-inch bazooka rocket	Less Sensitive	1 in 0.7 acre	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Farming, child play)	2 – 5 /2
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact
Clearance to Depth	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact

[1] Denotes items found during the EE/CA, as indicated. "Other" denotes items found during prior investigations or by the Public.

[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.5
IMPACT ANALYSIS
Area 4C

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth[2]**	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	**EE/CA: (1) unfuzed 105mm HE projectile Other: (1) unfuzed 155mm HE projectile**	Insensitive	1 in 2.3 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Construction, child play, hunting)	35 – 60 /8
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact
Clearance to Depth	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact

[1] Denotes items found during the EE/CA, as indicated.

[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.6
IMPACT ANALYSIS
Area 4D

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	**EE/CA: (1) 37mm HE projectile**	Less Sensitive	1 in 1.15 acre	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Hunting, hiking, child play)	5 – 10 /6
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact
Clearance to Depth	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact

[1] Denotes items found during the EE/CA, as indicated.

[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.7
IMPACT ANALYSIS
Area 4E

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	**EE/CA: (1) 37mm HE projectile**	Less Sensitive	1 in 0.7 acre	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Farming, child play, construction)	20 – 40 /1
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact
Clearance to Depth	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact

[1] Denotes items found during the EE/CA, as indicated.

[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.8
IMPACT ANALYSIS
Area 4

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[\1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[\2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	**EE/CA:** (1) 105mm HE projectile, (1) 57mm HE projectile, (1) M52 series nose fuze, (1) 2.36-inch HE bazooka rocket warhead, **(1) unfuzed 155mm shrapnel projectile with expelling charge.**	Less Sensitive	5 in 94.32 acres	Surface - 1 Subsurface - 4	No Restriction	Moderately Stable	Moderate (Child play, construction, hunting, farming, forestry, residential)	500 – 750 />200
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact
Clearance to Depth	No Impact	No Impact	**Impact**	**Impact**	No Impact	No Impact	**Impact**	No Impact

[\1] Denotes items found during the EE/CA, as indicated. [\2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.9
IMPACT ANALYSIS
Area 5

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[\1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[\2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population**
Existing Condition	**EE/CA:** Ordnance Scrap	Inert	0 in 30 acres	Not Applicable	No Restriction	Moderately Stable	Low (Child play, construction, hunting, farming, forestry)	5000 – 8000
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Clearance to Depth	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact

[\1] Denotes items found during the EE/CA, as indicated. "Other" denotes items found during the ASR SI although specifics were not provided.

[\2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

TABLE 7.10
IMPACT ANALYSIS
Lakeview Subdivision

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors	
	Type[1]	**Sensitivity**	**Number of UXO Found**	**Number of UXO by Depth**[2]	**Accessibility**	**Stability**	**Contact Level / Activities**	**Population /Number of Residential Dwellings**
Existing Condition	**EE/CA: (1) 37mm HE projectile** **TCRA: (1) electric blasting cap, (1) Mk II hand grenade, (1) 37mm HE projectile, (1) M1 A1 Mine fuze, (1) 2.36-inch HE rocket motor with fuze, (1) 2.36-inch HE bazooka rocket warhead**	Less Sensitive	**EE/CA**: 1 in 0.7 acre **TCRA**: 6 in 26 acres	Surface – 7 Subsurface - 0	No Restriction	Moderately Stable	Significant (Construction, child play)	30 – 50 /7
NDAI	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Institutional Controls	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**Impact**	**Impact**
Surface Clearance	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact
Clearance to Depth	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact

[1] Denotes items found during the EE/CA and TCRA investigations, as indicated. "Other" denotes items found during the ASR SI although specifics were not provided.
[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation and the TCRA.

Note – For all subsites implementation of ***site-wide*** IC components (varying by area) are considered viable and prudent and will therefore be retained through the screening process.

CHAPTER 8
COMPARATIVE ANALYSIS OF RESPONSE ACTION ALTERNATIVES

8.1 INTRODUCTION

8.1.1 The four alternatives identified for the former Camp Butner Site were analyzed in Chapter 7 with three evaluation criteria: effectiveness, implementability, and cost. The analysis was performed to screen the alternatives based on their compliance with the minimum requirements of the evaluation criteria. All four alternatives were retained for comparative analysis as outlined below:

Alternative 1 – No DoD Action Indicated at Area 5;

Alternative 2 – Site-specific Institutional Controls at Area 1A; Site-wide for all others;

Alternative 3 – Surface Clearance of UXO/OE at Area 4A and Area 4

Alternative 4 – Clearance to Depth of UXO/OE at Area 1A, Area 4, Area 4A, Area 4B, Area 4C, Area 4D, and Lakeview Subdivision.

Each of the above four alternatives met the minimum requirements of the evaluation criteria for at least one AOI. As discussed in Chapter 7, the criteria for NDAI is met for Area 5; therefore no further analysis is warranted. It should be noted that a subsurface clearance (to a depth of six inches bgs) has already been implemented at one AOI, Lakeview Subdivision, as part of the TCRA. Therefore, an analysis of the surface clearance alternative was not conducted for this AOI. A comparative analysis of the retained UXO/OE response action alternatives was conducted for the ten remaining AOIs.

8.1.2 A comparative analysis is presented in this chapter to determine the relative performance of the retained alternatives for each of the evaluation criteria. The purpose of this comparison was to determine the advantages and disadvantages of each of the alternatives relative to one another. This comparison was used to support the selection of the most appropriate UXO/OE response actions for each AOI. Similar to the initial alternative screening conducted in Chapter 7, the comparative analysis was performed by ranking each alternative relative to the other alternatives for effectiveness, implementability, and cost. However, each of the evaluation criteria were further analyzed by subcomponents.

8.1.3 For each of the subcomponents of an evaluation criterion, a ranking value was assigned for each of the retained alternatives, with "1" representing the best choice. In the case of two or more alternatives being equal for a criterion, an average ranking value was used for each alternative that is of equal value in the criterion. Ranking values were totaled for each alternative within the three evaluation criteria of effectiveness, implementability, and cost. However, not all subcomponents within each of the three evaluation criteria were weighted equally. The rankings for each evaluation criterion were combined and the alternative with the lowest overall score was selected as the preferred alternative for the AOI.

8.2 EFFECTIVENESS

8.2.1 Introduction

The retained alternatives for each AOI were ranked under the effectiveness category. The results of this ranking process are outlined in Tables 8.1 through 8.8. Based on this analysis, the site-wide IC only ranked highest in the effectiveness category for Area 4 and Area 4E (no other alternatives were retained during initial screening). Clearance to Depth ranked highest for the remaining areas (Area 1A, Area 4A, Area 4B, Area 4C, Area 4D, and Lakeview). The logic behind the rankings for the evaluation criteria is provided in the following paragraphs.

8.2.2 Overall Protection of Public Safety and Human Environment

8.2.2.1 The OE RIA process as described in "Interim Guidance, OE Risk Impact Assessment" (USACE, 2001b) was used to evaluate each alternative for overall protection of public safety and the human environment. This process provided a qualitative indication of the change in the potential for harm and level of protectiveness at the AOIs for each of the remaining alternatives. The impact of each of the remaining alternatives was evaluated by assigning an impact evaluation score of 'No Impact' or an alphabetical rank of 'A', 'B', or 'C' – with 'A' being the highest impact in reducing the potential for harm and increasing the level of protectiveness at the sector and a rank 'C' noting the lowest impact. This evaluation included three primary UXO/OE risk factors that were used in the risk assessment presented in Chapter 4 and the screening of the alternatives presented in Chapter 7. This evaluation is illustrated in Tables 8.9 through 8.16.

8.2.2.2 The implementation of site-wide ICs, as described in Chapter 7, would modify the behavior of the public and the activities they perform throughout the former Camp Butner Site. In Area 1A, an additional site-specific IC component was evaluated. This component includes installation of a boundary fence enclosure around the entire Area 1A AOI. This alternative was ranked as 'B' in Table 8.9 for the projected future activities and land use. The fence will restrict access to Area 1A, thus serving to modify behavior of pedestrian traffic. Finally, an overall rank of 'B' (moderate impact) was assigned to this alternative because while the fence will deter access by the public, it will not, by itself, eliminate the potential for harm from UXO/OE present in Area 1A.

Implementation of this alternative will not reduce the risk to the public from residual UXO/OE since it does not include any removal activity.

8.2.2.3 The Surface Clearance of OE alternative as described in Chapter 7 would remove UXO/OE items located on the surface in Area 4A, as described in Chapter 7. In Area 4A one UXO item (105mm HE projectile) and some ordnance related scrap was recovered on the ground surface. Therefore, surface clearance will provide some level of increased protection to the public in the AOI (over no removal action), based on current and future anticipated land use as well as contact level (see Chapter 4). This alternative was rated as having a moderate impact ('B') for most categories (Table 8.10).

8.2.2.4 The Clearance to Depth alternative for the remaining AOIs provides for enhanced overall protection of human health and the environment by removing residual UXO/OE suspected below the ground surface. Based on the confirmed presence of UXO combined with the current farming practices (primary land use) in Area 4B and Area 4D, the Clearance to Depth alternative will reduce the risk to the explosive hazard encountered from farm workers and other receptors (hunters, hikers, low-density residential, etc). Few residential dwellings are present (ranging from a low of two in Area 4B to a high of six in Area 4D) and near-term future development is not anticipated.

8.2.2.5 In Area 1A, Area 4A, and Area 4C, the exposure pathway is significant based on the confirmed presence of UXO, the definitive evidence of a pre-existing impact area (with exception of Area 1A), and the current and projected residential development in these AOIs. Although Area 4D consists of mostly undeveloped land (6 residential dwellings) the risk of exposure does potentially exist, and subsurface removal of residual UXO will increase the level of public protection.

8.2.2.6 The TCRA and DGM survey in the residential Lakeview Subdivision AOI indicate subsurface metallic debris remains, thus subsurface clearance would provide additional protection to the residential population. Therefore, the Clearance to Depth alternative would be more effective in reducing the explosive safety risk as it will mitigate UXO/OE items confirmed to be present in the subsurface.

8.2.2.7 Based on this evaluation, the Clearance to Depth alternative is the most protective of public safety for Area 1A, Area 4A, Area 4B, Area 4C, Area 4D, and the Lakeview Subdivision. In Tables 8.1 through 8.8 each alternative was ranked in order of overall effectiveness, ranking the Clearance to Depth alternative as Rank 1.

8.2.3 Compliance with ARARs

As described in Chapter 7, special consideration of ARARs that address activities within wetlands or areas exhibiting the characteristics of a wetland may be necessary for the surface clearance of UXO/OE alternative. For the purpose of this evaluation it is assumed that steps necessary to comply with these ARARs would be addressed if either

of the clearance alternatives were implemented for any of the AOIs. Therefore, since all the alternatives would comply with ARARs, they have been ranked equally.

8.2.4 Long-Term Effectiveness

The Clearance to Depth of UXO/OE alternative provides the best long-term effectiveness for all AOIs for which this alternative was retained after initial screening, with evaluation of each of the other alternatives resulting in a decreasing degree of long-term effectiveness. This ranking order has been selected for the same reasoning as that provided under the overall protection of public safety and environment criterion.

8.2.5 Short-Term Effectiveness

In Area 1A, the site-specific IC component (fencing) provides an increased level of protection to the public with regards to access restriction than does no action. However, because the IC alternative does not mitigate the explosive hazard risk from Area 1A, the Clearance to Depth alternative ranked higher with respect to effectiveness. The proper implementation of the IC alternative does directly impact public access to the AOI, thus providing short-term effectiveness to public safety (Table 8.1).

TABLE 8.1
EFFECTIVENESS CRITERIA APPLICATION
FOR AREA 1A

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-specific IC)	2	1	2	1	6	2
Clearance to Depth of UXO/OE	1	1	1	2	5	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.2
EFFECTIVENESS CRITERIA APPLICATION
FOR AREA 4A

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-wide)	3	1	3	1	8	3
Surface Clearance of UXO/OE	2	1	2	2	7	2
Clearance to Depth of UXO/OE	1	1	1	3	6	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.3
EFFECTIVENESS CRITERIA APPLICATION
FOR AREA 4B

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-wide)	2	1	2	1	6	2
Clearance to Depth of UXO/OE	1	1	1	2	5	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.4
EFFECTIVENESS CRITERIA APPLICATION
FOR AREA 4C

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-wide)	2	1	2	1	6	2
Clearance to Depth of UXO/OE	1	1	1	2	5	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.5
EFFECTIVENESS CRITERIA APPLICATION
FOR AREA 4D

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-wide)	2	1	2	1	6	2
Clearance to Depth of UXO/OE	1	1	1	2	5	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.6
EFFECTIVENESS CRITERIA APPLICATION
FOR AREA 4E

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-wide)	1	1	1	1	1	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.7
EFFECTIVENESS CRITERIA APPLICATION
FOR AREA 4

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-wide)	3	1	3	1	8	3
Surface Clearance of UXO/OE	2	1	2	2	7	2
Clearance to Depth of UXO/OE	1	1	1	3	6	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.8
EFFECTIVENESS CRITERIA APPLICATION
FOR LAKEVIEW SUBDIVISION

ALTERNATIVE	EFFECTIVENESS				SCORE	RANK
	Protection of Public Safety & Human Environment	Compliance with ARARs	Long-Term Effectiveness	Short-Term Effectiveness		
Institutional Controls (site-wide)	2	1	2	1	6	2
Clearance to Depth of UXO/OE	1	1	1	2	5	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.9
UXO/OE RISK IMPACT ANALYSIS
FOR AREA 1A

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[3]
	Type[1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[2]	Accessibility	Stability	Contact Level / Activities	Population /Number of Residential Dwellings	
Existing Condition	***Area 1A*:** **EE/CA:** (1) M1 anti-tank practice mine w/fuze, **(1) Mk II hand grenade**	Less Sensitive	2 in 1.15 acres	Surface – 0 Subsurface – 2	No Restriction	Moderately Stable	Significant (Trespassing and hiking)	0 – 5 /0	
Institutional Controls (site-specific)	No Impact	No Impact	No Impact	No Impact	**A**	No Impact	**B**	**A**	**B**
Clearance to Depth	No Impact	No Impact	**A**	**A**	No Impact	No Impact	**A**	No Impact	**A**

[1] Denotes items found during the EE/CA, as indicated.
[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.
[3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk within the sector and Rank 'B' indicating the least impact.

TABLE 8.10
UXO/OE RISK IMPACT ANALYSIS
FOR AREA 4A

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[3]
	Type[1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[2]	Accessibility	Stability	Contact Level / Activities	Population /Number of Residential Dwellings	
Existing Condition	**EE/CA: (1) 2.36-inch HE bazooka rocket**	Less Sensitive	1 in 1.15 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Construction, child play)	5 – 10 /2	
Institutional Controls (site-wide)	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**A**	**B**	**C**
Surface Clearance	No Impact	No Impact	**B**	**B**	No Impact	No Impact	**B**	No Impact	**B**
Clearance to Depth	No Impact	No Impact	**A**	**A**	No Impact	No Impact	**B**	No Impact	**A**

[1] Denotes items found during the EE/CA, as indicated.
[2] Denotes the number of UXO found at the and in the subsurface during the EE/CA field investigation.
[3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk within the sector and Rank 'C' indicating the least impact.

TABLE 8.11
UXO/OE RISK IMPACT ANALYSIS
FOR AREA 4B

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[3]
	Type[1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[2]	Accessibility	Stability	Contact Level / Activities	Population /Number of Residential Dwellings	
Existing Condition	**EE/CA: (1) 2.36-inch HE bazooka rocket** **Other:** (1) 2.36-inch bazooka rocket	Less Sensitive	1 in 0.7 acre	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Farming, child play)	2 – 5 /2	
Institutional Controls (site-wide)	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**A**	**B**	**B**
Clearance to Depth	No Impact	No Impact	**A**	**A**	No Impact	No Impact	**B**	No Impact	**A**

[1] Denotes items found during the EE/CA, as indicated.
[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.
[3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk within the sector and Rank 'B' indicating the least impact.

TABLE 8.12
UXO/OE RISK IMPACT ANALYSIS
FOR AREA 4C

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[3]
	Type[1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[2]	Accessibility	Stability	Contact Level / Activities	Population /Number of Residential Dwellings	
Existing Condition	**EE/CA:** (1) unfuzed 105mm HE projectile **Other: (2) unfuzed 155mm HE projectiles**	Insensitive	1 in 2.3 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Construction, child play, hunting)	35 – 60 /8	
Institutional Controls (site-wide)	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**A**	No Impact	**B**
Clearance to Depth	No Impact	No Impact	**A**	**A**	No Impact	No Impact	**B**	No Impact	**A**

[1] Denotes items found during the EE/CA, as indicated. "Other" denotes items found by others during the EE/CA investigations.
[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.
[3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk within the sector and Rank 'B' indicating the least impact.

TABLE 8.13
UXO/OE RISK IMPACT ANALYSIS
FOR AREA 4D

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[3]
	Type[1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[2]	Accessibility	Stability	Contact Level / Activities	Population /Number of Residential Dwellings	
Existing Condition	**EE/CA: (1) 37mm HE projectile**	Less Sensitive	1 in 1.15 acres	Surface – 0 Subsurface – 1	No Restriction	Moderately Stable	Significant (Hunting, hiking, child play)	5 – 10 /6	
Institutional Controls (site-wide)	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**A**	**B**	**B**
Clearance to Depth	No Impact	No Impact	**A**	**A**	No Impact	No Impact	**B**	No Impact	**A**

[1] Denotes items found during the EE/CA, as indicated.
[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.
[3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk within the sector and Rank 'B' indicating the least impact.

TABLE 8.14
UXO/OE RISK IMPACT ANALYSIS
FOR AREA 4E

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[\3]
	Type[\1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[\2]	Accessibility	Stability	Contact Level / Activities	Population /Number of Residential Dwellings	
Existing Condition	**EE/CA: (1) 37mm HE projectile**	Less Sensitive	1 in 0.7 acres	Surface – 0 Subsurface – 1	No Restriction	Moderate ly Stable	Significant (Farming construction)	20 – 40 /1	
Institutional Controls (site-wide)	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**A**	**B**	**A**

[\1] Denotes items found during the EE/CA, as indicated.
[\2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.
[\3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk.

TABLE 8.15
UXO/OE RISK IMPACT ANALYSIS
FOR AREA 4

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[3]
	Type[1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[2]	Accessibility	Stability	Contact Level / Activities	Population	
Existing Condition	**EE/CA:** (1) 105mm HE projectile, (1) 57mm HE projectile, (1) M52 series nose fuze, (1) 2.36-inch HE bazooka rocket warhead, **(1) unfuzed 155mm shrapnel projectile with expelling charge.**	**Less Sensitive**	5 in 94.32 acres	Surface - 1 Subsurface - 4	No Restriction	Moderately Stable	Moderate (Child play, construction, hunting, farming, forestry, residential)	500 – 750 />200	
Institutional Controls (site-wide)	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**A**	**B**	**C**
Surface Clearance	No Impact	No Impact	**B**	**B**	No Impact	No Impact	**B**	No Impact	**B**
Clearance to Depth	No Impact	No Impact	**A**	**A**	No Impact	No Impact	**B**	No Impact	**A**

[1] Denotes items found during the EE/CA, as indicated.
[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation.
[3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk within the sector and Rank 'C' indicating the least impact.

TABLE 8.16
UXO/OE RISK IMPACT ANALYSIS
FOR LAKEVIEW SUBDIVISION

Alternative	Ordnance and Explosive Factors				Site Characteristics Factors		Human Factors		Overall Rank[3]
	Type[1]	Sensitivity	Number of UXO Found	Number of UXO by Depth[2]	Accessibility	Stability	Contact Level / Activities	Population /Number of Residential Dwellings	
Existing Condition	**EE/CA:** (1) 37mm HE projectile **TCRA:** (1) electric blasting cap, **(1) MkII hand grenade**, (1) 37mm HE projectile, (1) M1 A1 Mine fuze, (1) 2.36-inch HE rocket motor with fuze, (1) 2.36-inch HE bazooka rocket warhead	Less Sensitive	**EE/CA**: 1 in 0.7 acre **TCRA**: 6 in 26 acres	Surface – 0 Subsurface – 7	No Restriction	Moderately Stable	Significant (Construction, child play)	30 – 50 /7	
Institutional Controls (site-wide)	No Impact	No Impact	No Impact	No Impact	No Impact	No Impact	**A**	**B**	**B**
Clearance to Depth	No Impact	No Impact	**A**	**A**	No Impact	No Impact	**B**	No Impact	**A**

[1] Denotes items found during the EE/CA and TCRA investigations, as indicated.
[2] Denotes the number of UXO found at the surface and in the subsurface during the EE/CA field investigation and the TCRA.
[3] Overall Rank 'A' being the alternative with most significant impact in reducing the safety risk within the sector and Rank 'B' indicating the least impact.

8.3 IMPLEMENTABILITY

8.3.1 Introduction

The alternatives for each of the AOIs were ranked within each of the six criteria within the implementability category based on a subjective analysis of the merits of each alternative. The results of this analysis are presented in Tables 8.17 through 8.24. Based on this comparative analysis, the site-wide IC alternative was ranked highest for Area 4D, Area 4E and Area 4. The Surface Clearance alternative did not rank the highest for any AOI. The Clearance to Depth alternative ranked highest in implementability for Area 1A, Area 4A, Area 4B, Area 4C, and Lakeview Subdivision. The logic behind the rankings for the evaluation criteria is provided in the following paragraphs.

8.3.2 Technical Feasibility

In this criterion, the alternatives for all ten AOIs were ranked with the site-wide IC alternative being the easiest to implement from a technical standpoint. In comparison, the Surface Clearance alternative increases in technical difficulty to implement while the Clearance to Depth of UXO/OE alternative is the most difficult to implement.

8.3.3 Administrative Feasibility

The site-wide IC alternative requires coordination between the local agencies associated with the former Camp Butner Site. This alternative also requires a long-term commitment from local agencies, including annual reinforcement and repair. Administratively, the clearance alternatives will likely be somewhat more difficult to implement than the IC alternative.

8.3.4 Availability of Services and Materials

The site-wide and site-specific IC alternatives, described in Chapter 5 require a moderate amount of readily available services and materials for implementation. The level of difficulty increases with the Surface Clearance alternative due to securing sufficient qualified labor resources. Difficulty increases further with the Clearance to Depth alternative given the services and materials associated with the involvement of more extensive excavation (greater land survey, more extensive brush clearance, mechanized excavation, etc.).

8.3.5 Property Owner Acceptance

Each alternative was rated based on the degree of acceptance anticipated by the property owner. This criteria is weighted in importance by a factor of two. Given the project team correspondence, public meetings responses, and direct interaction of Parsons personnel with local property owners, the level of acceptance to a particular UXO/OE response alternative can be gauged on a case by case basis. For example, in Area 4D the IC alternative was ranked highest due to the likely perception anticipated by land owners that any surface or subsurface removal action will displace them from their property and render the land unusable (for hunting) during the clearance interim. The Clearance to

Depth was ranked highest in Area 1A, Area 4A, Area 4B, Area 4C, and the Lakeview Subdivision where the property owners are perceived as amenable to UXO/OE clearance of their land as a means of reducing the explosive risk hazard. Because of the numerous property owners and various land uses within the greater Area 4, the IC alternative ranked highest based on the likelihood of majority acceptance in this area.

TABLE 8.17
IMPLEMENTABILITY CRITERIA APPLICATION
FOR AREA 1A

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-specific)	1	1	1	4	2	2	11	2
Clearance to Depth	2	2	2	2	1	1	10	1

Note: Ranking from best to worst; best = 1, worst = 2

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking.
2. Property Owner Acceptance multiplied by 2

TABLE 8.18
IMPLEMENTABILITY CRITERIA APPLICATION
FOR AREA 4A

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-wide)	1	1	1	6	3	3	15	3
Surface Clearance	2	2	2	4	2	2	14	2
Clearance to Depth	3	3	2	2	1	1	12	1

Note: Ranking from best to worst; best = 1, worst = 2

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking.
2. Property Owner Acceptance multiplied by 2

TABLE 8.19
IMPLEMENTABILITY CRITERIA APPLICATION
FOR AREA 4B

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-wide)	1	1	1	4	2	2	11	2
Clearance to Depth	2	2	2	2	1	1	10	1

Note: Ranking from best to worst; best = 1, worst = 2

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking.
2. Property Owner Acceptance multiplied by 2.

TABLE 8.20
IMPLEMENTABILITY CRITERIA APPLICATION
FOR AREA 4C

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-wide)	1	1	1	4	2	2	11	2
Clearance to Depth	2	2	2	2	1	1	10	1

Note: Ranking from best to worst; best = 1, worst = 2

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking.
2. Property Owner Acceptance multiplied by 2.

TABLE 8.21
IMPLEMENTABILITY CRITERIA APPLICATION
FOR AREA 4D

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-wide)	1	1	1	2	2	2	9	1
Clearance to Depth	2	2	2	4	1	1	12	2

Note: Ranking from best to worst; best = 1, worst = 2

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking.
2. Property Owner Acceptance multiplied by 2.

TABLE 8.22
IMPLEMENTABILITY CRITERIA APPLICATION
FOR AREA 4E

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-wide)	1	1	1	2	1	1	7	1

Note: Ranking from best to worst; best = 1, worst = 2

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking.
2. Property Owner Acceptance multiplied by 2.

TABLE 8.23
IMPLEMENTABILITY CRITERIA APPLICATION
FOR AREA 4

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-wide)	1	1	1	2	3	1	9	1
Surface Clearance	2	2	2	4	2	1	13	2
Clearance to Depth	3	3	2	6	1	1	16	3

Note: Ranking from best to worst; best = 1, worst = 3

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking. The size and demographic diversity of Area 4 combined with varying land use suggest that concurrence on a specific action may be difficult to obtain.
2. Property Owner Acceptance multiplied by 2.

TABLE 8.24
IMPLEMENTABILITY CRITERIA APPLICATION
FOR LAKEVIEW SUBDIVISION

ALTERNATIVE	IMPLEMENTABILITY						SCORE	RANK
	Technical Feasibility	Administrative Feasibility	Availability of Services & Materials	Property Owner Acceptance[1,2]	Local Agency Acceptance[1]	Community Acceptance[1]		
Institutional Controls (site-wide)	1	1	1	4	2	2	11	2
Clearance to Depth	2	2	2	2	1	1	10	1

Note: Ranking from best to worst; best = 1, worst = 2

1. Input has not been received regarding local agency and community acceptance of the response action alternatives. Generally, the stakeholders prefer the more ambitious response action alternative. However, input received from these stakeholders during the public comment period for this draft EE/CA report will be incorporated into the final EE/CA report and may affect this ranking.
2. Property Owner Acceptance multiplied by 2.

8.3.6 Local Agency Acceptance

Each alternative is rated based on the degree of acceptance expressed by local agencies. The local agency acceptance of the remaining alternatives is not fully known at this time; however, local agencies generally prefer the most ambitious clearance alternative. For the AOIs within the former Camp Butner Site, Clearance to Depth was ranked as the preferred alternative from the local agencies' perspective (for AOIs in which subsurface clearance was retained) and the IC alternative alone was ranked as the least preferred. Input received from local agencies as part of the public comment period for this EE/CA report was incorporated into this final report.

8.3.7 Community Acceptance

Each alternative is rated based on the degree of acceptance expressed by the local community. Through public meetings and IA interviews, the community places public safety as the primary goal. A heightened public awareness and concern has been generated in the course of the EE/CA and TCRA investigation at the former Camp Butner Site. It is anticipated that the community will generally support the most ambitious alternative based on input gathered to date. Input received from the community as part of the public comment period for this EE/CA report was incorporated into this final report.

8.4 COST

The IA performed for the former Camp Butner Site (Appendix F) indicated the initial capital cost to implement the recommended site-wide and site-specific ICs (as described in Appendix F, Section 4.5) is approximately $80,750 with an estimated $10,500 annual cost. The estimated cost Tables 8.25 through 8.33 present the estimated cost for the Surface Clearance and / or Clearance to Depth alternatives for the eight AOIs with confirmed or suspect UXO/OE. The recommended NDAI alternative for Area 5 has no initial cost. Recurring review costs are discussed in Chapter 10.

8.5 OVERALL RANKING

8.5.1 The overall ranking of the alternatives for the ten AOIs with confirmed or suspect UXO/OE are presented in Tables 8.34 through 8.41. Using the same methodology used in the previous categories, the preferred alternative is the one with the lowest overall score. Based on this analysis, site-wide Institutional Controls alternative ranked highest for Area 4D, Area 4E, and Area 4. The Clearance to Depth alternative is the preferred alternative for Area 1A, Area 4A, Area 4B, Area 4C, and the Lakeview Subdivision.

8.5.2 Further input from stakeholders will be solicited during subsequent Public Meetings and incorporated, where appropriate, into the recommended alternative for each of the AOIs.

Table 8.25

Area 1A[1]
Clearance to Depth of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Clearance to Depth OE Removal[2]	$10,320	20	$276,000
A-E Field Oversight[3]	$1,238	20	$33,120
A-E Project Management[4]	$825	20	$22,080
Land Survey[5]	Lump-Sum	20	$10,000
Brush Cut[6]	$3000	20	$60,000
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$17,000
Costs Contracting & Oversight[9]	N/A	N/A	$51,180
		Subtotal	**$410,000**
10% Contingency			$39,000
	Total Cost Estimate*		**$449,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are no existing residential dwellings within Area 1A although development is present to the immediate south.

[1] The costing is based on the assumption that the ***Subsurface Clearance to 1 foot*** will be implemented independently of any other OE removal action. The costs may be less if the clearance is contracted and implemented concurrently with other sites.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. ***Cost is based on "Mag and Flag" removal technique***. The number of anomalies requiring investigation is estimated to be between 100 - 300 per acre based on the EE/CA data. A multiplier of 1.2 was used to account for vegetation and terrain. Two UXO items recovered during the EE/CA at depths of 1 inch and 10 inches. All other anomalies were encountered within 1 foot of ground surface, with most less than 6 inches in depth.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 100'x100' contiguous grid network within the site.

[6] Brush cutting costs based on the moderate vegetation density at the site and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

[7] Site Specific Institutional Controls measures are not planned for this site.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.26

Area 4A[1]
Surface Clearance of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Surface OE Removal[2]	$2,640	34	$89,760
A-E Field Oversight[3]	$317	34	$10,771
A-E Project Management[4]	$211	34	$7,181
Land Survey[5]	Lump-Sum	34	$17,000
Brush Cut[6]	$1,700	34	$57,800
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$3,060
Costs Contracting & Oversight[9]	N/A	N/A	$27,377
		Subtotal	**$213,000**
10% Contingency			$21,000
		Total Cost Estimate*	**$234,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 2 existing residential dwellings within Area 4A as of July 3, 2003 according to county records (both owned by the same property owner).

[1] The costing is based on the assumption that the ***Surface Clearance*** will be implemented independently of any other OE removal action. The costs may be less if the clearance is contracted and implemented concurrently with other sites.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. The number of surface anomalies requiring investigation is estimated to be between 100 - 300 per acre based on the EE/CA data. A multiplier of 1.2 was used to account for vegetation and terrain. No UXO items were recovered during the EE/CA on the surface in 1.15 acres investigated although several OE scrap items were present and the penetration depth of 2.36-inch rockets suggests UXO on the surface may be present.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 500'x500' contiguous grid network within the site.

[6] Brush cutting costs based on the moderate vegetation density at the site and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.27

Area 4A[1]
Clearance to Depth of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Clearance to Depth OE Removal[2]	$10,320	34	$350,880
A-E Field Oversight[3]	$1,238	34	$42,106
A-E Project Management[4]	$826	34	$28,071
Land Survey[5]	Lump-Sum	34	$21,000
Brush Cut[6]	$2,100	34	$71,400
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$5,100
Costs Contracting & Oversight[9]	N/A	N/A	$27,377
		Subtotal	**$595,000**
10% Contingency			$60,000
		Total Cost Estimate*	**$655,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 2 existing residential dwellings within Area 4A as of July 3, 2003 according to county records (both owned by the same property owner).

[1] The costing is based on the assumption that the ***Subsurface Clearance (estimated to be generally not greater than 1 foot bgs based on EE/CA findings, ordnance types anticipated, and soil/terrain)*** will be implemented independently of any other OE removal action. The costs may be less if the clearance is contracted and implemented concurrently with other sites.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. ***Cost is based on manual digital geophysical mapping (DGM).*** The number of anomalies requiring investigation after DGM is estimated to be 25-75 per acre based on EE/CA data. A multiplier of 1.2 was used to account for vegetation and terrain. One UXO item was recovered during the EE/CA at a depth of 3 inches. All other anomalies were encountered within 6 inches of ground surface.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 100'x100' contiguous grid network within the site.

[6] Brush cutting costs based on the moderate vegetation density at the site and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

[7] Site Specific Institutional Controls measures are not planned for this site.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.28

Area 4B[1]
Clearance to Depth of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Clearance to Depth OE Removal[2]	$12,200	10	$122,000
A-E Field Oversight[3]	$1,464	10	$14,640
A-E Project Management[4]	$976	10	$9,760
Land Survey[5]	Lump-Sum	10	$8,000
Brush Cut[6]	$250	10	$2,500
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$680
Costs Contracting & Oversight[9]	N/A	N/A	$23,535
		Subtotal	**$181,000**
10% Contingency			$18,000
	Total Cost Estimate*		**$199,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 2 existing residential dwellings within Area 4B as of July 3, 2003 according to county records.

1 The costing is based on the assumption that the ***Subsurface Clearance (estimated to be generally not greater than1-2 feet bgs based on EE/CA findings, ordnance types anticipated, and soil/terrain)*** will be implemented independently of any other OE removal action. The costs may be less if the clearance is contracted and implemented concurrently with other sites.

2 Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. ***Cost is based on manual digital geophysical mapping (DGM).*** The number of anomalies requiring investigation after DGM is estimated to be 25-75 per acre based on EE/CA data. A multiplier of 1.0 was used to account for vegetation and terrain. One UXO item was recovered during the EE/CA at a depth of 18 inches but not from within the farmed area. All other anomalies were encountered within 6 inches of ground surface.

3 A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

4 A-E Project Management estimated at 8% of ordnance removal costs.

5 Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 100'x100' contiguous grid network within the site.

6 Brush cutting costs based on the light vegetation density at the agricultural portion of the site proposed for removal action and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

7 Site Specific Institutional Controls measures are not planned for this site.

8 Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

9 Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.29

Area 4C[1]
Clearance to Depth of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Clearance to Depth OE Removal[2]	$13,000	16	$208,000
A-E Field Oversight[3]	$1,560	16	$24,960
A-E Project Management[4]	$1040	16	$16,640
Land Survey[5]	Lump-Sum	16	$15,000
Brush Cut[6]	$500	16	$8,000
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$8,160
Costs Contracting & Oversight[9]	N/A	N/A	$40,890
		Subtotal	**$321,000**
10% Contingency			$32,000
		Total Cost Estimate*	**$353,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 8 existing residential dwellings within Area 4C as of July 3, 2003 according to county records.

[1] The costing is based on the assumption that the ***Subsurface Clearance (estimated to be no greater than 30 inches bgs based on EE/CA findings, ordnance types anticipated, and soil/terrain)*** will be implemented independently of any other OE removal action. The costs may be less if the clearance is contracted and implemented concurrently with other sites.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. ***Cost is based on manual digital geophysical mapping (DGM).*** The number of anomalies requiring investigation after DGM is estimated to be >75 per acre based on EE/CA data. A multiplier of 1.0 was used to account for vegetation and terrain. One UXO item was recovered during the EE/CA at a depth of 3 inches. All other anomalies were encountered within 30 inches of ground surface, most within the top 12 inches.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 100'x100' contiguous grid network within the site.

[6] Brush cutting costs based on the light vegetation density at the site and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

[7] Site Specific Institutional Controls measures are not planned for this site.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.30

Area 4D[1]
Clearance to Depth of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Clearance to Depth OE Removal[2]	$15,000	317	$4,755,000
A-E Field Oversight[3]	$1,800	317	$570,600
A-E Project Management[4]	$1,200	317	$380,400
Land Survey[5]	Lump-Sum	317	$180,000
Brush Cut[6]	$250	317	$79,250
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$16,320
Costs Contracting & Oversight[9]	N/A	N/A	$894,7880
		Subtotal	**$6,877,000**
10% Contingency			$686,000
		Total Cost Estimate*	**$7,563,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 6 existing residential dwellings within Area 4D as of July 3, 2003 according to county records.

[1] The costing is based on the assumption that the ***Subsurface Clearance (estimated to be generally not greater than 2 feet bgs based on EE/CA findings, ordnance types anticipated, and soil/terrain)*** will be implemented independently of any other OE removal action. The costs may be less if the clearance is contracted and implemented concurrently with other sites. Estimated 70% of site has been cleared for agricultural use (317 acres). Undeveloped/wooded tracts are not proposed for clearance.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. ***Cost is based on "Mag and Flag" technique as terrain deemed to difficult to DGM***. The number of anomalies requiring investigation is estimated to be between 100 - 300 per acre based on the EE/CA data. A multiplier of 1.2 was used to account for vegetation and terrain. One UXO item was recovered during the EE/CA at depths of 2 inches. All other anomalies were encountered within 1 foot of ground surface, with most less than 6 inches in depth.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 100'x100' contiguous grid network within the site.

[6] Brush cutting costs based on the light vegetation density at the site (agriculturally-used fields) and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

[7] Site Specific Institutional Controls measures are not planned for this site.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.31

Area 4[1]
Surface Clearance of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Surface OE Removal[2]	$2,750	21139	$58,132,250
A-E Field Oversight[3]	$330	21139	$6,975,870
A-E Project Management[4]	$220	21139	$4,650,580
Land Survey[5]	Lump-Sum	21139	$3,000,000
Brush Cut[6]	$750	21139	$15,854,250
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$1,377,000
Costs Contracting & Oversight[9]	N/A	N/A	$13,291,942
		Subtotal	**$103,282,000**
10% Contingency			$10,191,000
	Total Cost Estimate*		**$113,473,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 225 existing residential dwellings within Area 4 as of July 3, 2003 according to county records (both owned by the same property owner).

[1] The costing is based on the assumption that the ***Surface Clearance*** will be implemented independently of any other OE removal action.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. The number of surface anomalies requiring investigation is estimated to be between 50+ per acre based on the EE/CA data. A multiplier of 1.25 was used to account for vegetation and terrain.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 500'x500' contiguous grid network within the site.

[6] Brush cutting costs based on the moderate vegetation density at the site and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.32

Area 4[1]
Clearance to Depth of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Clearance to Depth OE Removal[2]	$14,700	21139	$310,743,300
A-E Field Oversight[3]	$1,764	21139	$37,289,196
A-E Project Management[4]	$1,176	21139	$24,859,464
Land Survey[5]	Lump-Sum	21139	$3,000,000
Brush Cut[6]	$1,500	21139	$31,708,500
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$3,000,000
Costs Contracting & Oversight[9]	N/A	N/A	$61,140,069
		Subtotal	**$471,741,000**
10% Contingency			$46,874,000
		Total Cost Estimate*	**$518,615,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 225 existing residential dwellings within Area 4 as of July 3, 2003 according to county records (both owned by the same property owner).

[1] The costing is based on the assumption that the ***Subsurface Clearance (estimated to be generally not greater than 1 foot bgs based on EE/CA findings, ordnance types anticipated, and soil/terrain)*** will be implemented independently of any other OE removal action.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. ***Cost is based on towed digital geophysical mapping (DGM combined with mag and dig).*** The number of anomalies requiring investigation after DGM is estimated to be >300 per acre based on EE/CA data. A multiplier of 1.5 was used to account for vegetation and terrain.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs are lump sum estimates derived from actual costs incurred on similar efforts and include marking site boundaries and establishing a 100'x100' contiguous grid network within the site.

[6] Brush cutting costs based on the moderate vegetation density at the site and is obtained from USAESCH Cost Estimating Guide combined with professional judgment and costs incurred for this task at similar sites.

[7] Site Specific Institutional Controls measures are not planned for this site.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

Table 8.33

Lakeview Subdivision[1]
Clearance to Depth of UXO/OE Cost Estimate
Camp Butner EE/CA

Item	Cost per Acre	Acreage	Total Costs
Clearance to Depth OE Removal[2]	$8,400	26	$224,172
A-E Field Oversight[3]	$1,008	26	$26,900
A-E Project Management[4]	$672	26	$17,934
Land Survey[5]	Lump-Sum	26	$5,000
Brush Cut[6]	$400	26	$10,400
Institutional Controls[7]	N/A	N/A	$0
Evacuation Costs[8]	N/A	N/A	$13,600
Costs Contracting & Oversight[9]	N/A	N/A	$42,661
		Subtotal	**$337,000**
10% Contingency			$37,000
		Total Cost Estimate*	**$374,000**

* Note: The total cost estimate is rounded to the nearest $1000 for the EE/CA. Detailed cost estimates are presented in Appendix G. There are 7 existing residential dwellings within Lakeview as of July 3, 2003 according to county records.

[1] The costing is based on the assumption that the ***Subsurface Clearance (estimated to be generally no greater than 24 inches bgs based on EE/CA findings, ordnance types anticipated, TCRA DGM interpretation, and soil/terrain)*** will be implemented independently of any other OE removal action. Assumes reacquisition/investigation of approximately 1500 anomalies identified from interpretation of TCRA DGM survey (Appendix B). The costs may be less if the clearance is contracted and implemented concurrently with other sites.

[2] Cost for OE Removal is based on the USAESCH Cost Estimating Guide and professional judgment for site-specific conditions. ***Cost excludes manual digital geophysical mapping (DGM) which was already conducted as part of the TCRA.*** The number of anomalies requiring investigation after DGM is estimated to be 25-75 per acre based on EE/CA data and USAESCH TCRA DGM interpretation. A multiplier of 1.2 was used to account for vegetation and terrain. Seven UXO items were recovered during the EE/CA and TCRA at a depths less than 6 inches. Includes police support costs for securing MSD and Road Closure, as detailed in Appendix G.

[3] A-E Field Oversight estimated at 12% of total ordnance removal costs. Includes documentation and reporting.

[4] A-E Project Management estimated at 8% of ordnance removal costs.

[5] Land survey costs based on actual costs incurred during TCRA and include marking site boundaries and re-establishing a 100'x100' contiguous grid network previously surveyed during the TCRA.

[6] Brush cutting costs based on the light vegetation since the site was recently brush cut as part of the TCRA.

[7] Site Specific Institutional Controls measures are not planned for this site.

[8] Evacuation Costs estimated based on estimated project duration and residential population – see Appendix G.

[9] Costs for Contracting and Oversight are estimated at 15% of the subtotal cost.

TABLE 8.34
SELECTION CRITERIA APPLICATION
FOR AREA 1A

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide and site-specific)	2	2	1	5	2
Clearance to Depth	1	1	2	4	1

Note: Ranking from best to worst; best = 1, worst = 2

TABLE 8.35
SELECTION CRITERIA APPLICATION
FOR AREA 4A

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide)	3	3	1	7	3
Surface Clearance	2	2	2	6	2
Clearance to Depth	1	1	3	5	1

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.36
SELECTION CRITERIA APPLICATION
FOR AREA 4B

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide)	2	2	1	5	2
Clearance to Depth	1	1	2	4	1

Note: Ranking from best to worst; best = 1, worst = 2

TABLE 8.37
SELECTION CRITERIA APPLICATION
FOR AREA 4C

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide)	2	2	1	5	2
Clearance to Depth	1	1	2	4	1

Note: Ranking from best to worst; best = 1, worst = 2

TABLE 8.38
SELECTION CRITERIA APPLICATION
FOR AREA 4D

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide)	2	1	1	4	1
Clearance to Depth	1	2	2	5	2

Note: Ranking from best to worst; best = 1, worst = 2

TABLE 8.39
SELECTION CRITERIA APPLICATION
FOR AREA 4E

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide)	1	1	1	3	1

Note: Ranking from best to worst; best = 1

TABLE 8.40
SELECTION CRITERIA APPLICATION
FOR AREA 4

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide)	3	1	1	5	1
Surface Clearance	2	2	2	6	2
Clearance to Depth	1	3	3	7	3

Note: Ranking from best to worst; best = 1, worst = 3

TABLE 8.41
SELECTION CRITERIA APPLICATION
FOR LAKEVIEW SUBDIVISION

Alternatives	Effectiveness	Implementability	Cost	Total	Rank
Institutional Controls (site-wide)	2	2	1	5	2
Clearance to Depth	1	1	2	4	1

Note: Ranking from best to worst; best = 1, worst = 2

CHAPTER 9
RECOMMENDED RESPONSE ACTION ALTERNATIVES

9.1 INTRODUCTION

9.1.1 UXO/OE response action alternatives were evaluated for each of the AOIs within the former Camp Butner Site that were investigated during this EE/CA investigation. Each potential alternative was initially screened against the general evaluation criteria of effectiveness, implementability, and cost. The screening of alternatives detailed in Chapter 7 was used to identify candidate UXO/OE response alternatives for further qualitative evaluation as tabulated in Chapter 8. Site-wide IC components were evaluated and selected as presented in Appendix F. As a result of the comprehensive evaluation of alternatives by AOI, the following paragraphs present the recommendations for implementation.

9.1.2 A recommendation of implementation of site-wide IC only (no removal at this time) has been deemed appropriate for several areas (Area 4, Area 4D, and Area 4E). The presence of UXO was confirmed either during the EE/CA or inferred based on the presence of HE projectile fragments in these areas but current and future anticipated land use, terrain, exposure pathways, and other factors (outlined in Chapter 4) indicate a removal action is not justified at the present time. However, to ensure public safety associated with the existing residential component in each of these areas, a subsurface removal action is recommended (comprising a two-acre residential footprint) encompassing each existing dwelling. The depth of the removal action will be based on the EE/CA findings but as a general rule all anomalies identified by the geophysical equipment will be excavated. The cost associated with each residential removal action within the IC sectors is estimated as $32,367 (per 2 acres), as detailed in Appendix G. Following property owner request, USACE will request funds for implementation of the removal action.

9.2 RECOMMENDATIONS

9.2.1 Area 1A

9.2.1.1 Presently, the 20 acres comprising Area 1A are undeveloped with no current land use assignment. The property ***is not*** within an area deed-restricted for "surface use only" following military occupation and property transfer. Future plans at this AOI include land use for recreational activities and the passage of a greenway / trail system. Recently obtained information also indicates plans for a day care facility and other development within, and adjacent to, this property. During the EE/CA

investigation, two UXO items were recovered including a Mk II hand grenade and a M4 practice landmine with spotting charge and fuze. A total of 5 OE scrap items identified as inert/expended M15 hand grenades were recovered at this AOI. Both UXO items and all OE scrap were found at 10 inches or less bgs.

9.2.1.2 EE/CA findings suggest that former military land use included grenade training (in addition to flamethrower training) and confirmed the risk of UXO explosive hazards within Area 1A. As discussed in Subchapter 7.5.3, the majority of residual UXO (if not all) is anticipated to be subsurface and extend to a depth of ten inches bgs. ***Therefore, the Subsurface Clearance and Institutional Controls (site-wide) alternatives are both recommended as the OE response alternative for implementation at Area 1A.*** The estimated cost to implement the subsurface clearance alternative for Area 1A is $448,618. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance.

9.2.2 Area 4A

9.2.2.1 Area 4A, comprising approximately 34 acres, has been parceled in anticipation of residential development and is actively being marketed. Although currently most of the land remains wooded and undeveloped, some grading and tree removal has been initiated. The ASR and TEC report indicates former military use of this general area as a bazooka and rifle grenade range Area 4A falls entirely within the boundary of the area deed-restricted for "surface use only" (see paragraph 2.3.6) following military occupation and property transfer. The single UXO and majority of OE scrap items recovered from this AOI were associated with 2.36-inch rockets. The only other ordnance type recovered from the AOI was a single OE scrap item identified as a component of an M9 rifle grenade. All ordnance related items were recovered within 6 inches bgs.

9.2.2.2 The EE/CA findings concurred with ASR designation of the AOI. Based on the types of ordnance found and those historically reported in this area, depth of penetration is not anticipated to exceed 6 inches bgs (Subchapter 7.6.3.1). ***Therefore, the Subsurface Clearance to Depth and Institutional Controls (site-wide) alternatives are both recommended as the OE response alternative for implementation at Area 4A. In addition, considering the imminent residential development, UXO construction support is warranted and will be provided to the new property owners at their request (provided sufficient advance notice).*** The estimated cost to implement the subsurface clearance alternative for Area 4A is $654,622. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance. In the interim, it is recommended that CESAW issue "prudent man letters" to the new property owners and residents within the AOI advising them of the potential presence of UXO on their property and appropriate actions to take if UXO is encountered.

9.2.3 Area 4B

9.2.3.1 Land use within the approximately 20 acres comprising Area 4B is dedicated to farming, with future land use anticipated to remain the same. Findings

reported in the ASR refer to former military use of this AOI for bazooka and rifle grenade training (similar to Area 4A). Area 4B falls entirely within the boundary of the area deed-restricted for "surface use only" (see paragraph 2.3.6) following military occupation and property transfer. Findings made during the EE/CA investigation included one UXO identified as a 2.36-inch rocket (recovered at 18 inches bgs) and four OE scrap items identified as HE fragments recovered within 6 inches bgs. Other findings include the reported discovery of numerous inert 2.36-inch rockets made by one of the property owners in recent years as well as during the EE/CA investigation.

9.2.3.2 Based on the types of ordnance found and historically reported in this area, depth of penetration is not expected to exceed 6 inches bgs. The recovery of the 2.36-inch HE bazooka rocket (UXO) at 18 inches bgs in a wooded area is not considered indicative of the vertical extent of contamination. However due to intrusive farming activities (e.g. tilling) over a portion of the AOI, the top layer of soil is regularly being turned over which potentially affects the vertical distribution of and contact with residual UXO/OE. Per the property owner, tilling at this AOI only penetrates the top ten inches of soil. ***Therefore, the Subsurface Clearance to Depth and Institutional Controls (site-wide) alternatives are both recommended as the OE response alternative for implementation within the agriculturally used portion of Area 4B (approximately 10 acres). No removal action within the undeveloped balance of the 20 acre AOI is warranted at this time. For the two existing homesteads identified within the AOI, a 2-acre subsurface removal action (per homestead) will be conducted encompassing the primary residential footprint***. If conditions at this AOI significantly change, re-evaluation will be conducted as part of the recurring review process (Chapter 10). In the interim, it is recommended that CESAW issue "prudent man letters" to both residents within the AOI advising them of the potential presence of UXO on their property and appropriate actions to take if UXO is encountered. The estimated cost to implement the subsurface clearance alternative for Area 4C is $199,159. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance.

9.2.4 Area 4C

9.2.4.1 Land use in the approximately 126-acre Area 4C is divided into low density residential development (8 total dwellings) in the southern half and undeveloped woodland in the northern half. Based on the current status of development in this area, future additional development is anticipated, particularly in the southern region. Analysis of TEC historic aerial photographs identifies suspect impact craters within the borders of Area 4E. The ASR and verified structural remnants indicate Area 4C was the location of the mock German village, an artillery target area. As a result, Area 4C falls within the boundary of the area deed-restricted for "surface use only" (see paragraph 2.3.6) following military occupation and property transfer. One UXO (105mm projectile) recovered at 3 inches bgs and approximately 217 pounds of HE projectile fragments were removed from this AOI. Other findings by an adjacent property owner in the southern portion of the AOI include one 105mm projectile and one 155mm projectile.

9.2.4.2 During the screening process several factors were assessed in the determination of the most suitable response action in Area 4C. These factors include land use, vertical extent of contamination, and associated costs with a UXO/OE removal action over 126-acre site. Initial, consideration was given to the different land uses for this AOI which can be divided at the power line easement into residential and undeveloped. Based on the ordnance type identified in this area and potential of exposure for local inhabitants, a removal action is recommended for the southern half of the AOI where the eight residential dwellings currently exist. ***Therefore, the Subsurface Clearance to Depth and Institutional Controls (site-wide) alternatives are both recommended as the OE response alternative for implementation within readily accessible and open residential parcels located within the <u>southern</u> half (estimated to encompass approximately 16 acres). In addition, UXO construction support is warranted and should be provided to the residential property owners at their request (provided sufficient advance notice).*** The estimated cost to implement the subsurface clearance alternative for Area 4C is $352,999. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance.

9.2.4.3 Due to the current lack of development and limited public access, the northern half of Area 4C does not warrant the same level of clearance as is recommended for the southern half. ***Considering the potential for residential development, UXO construction support is warranted and should be provided to the property owners at their request (provided sufficient advance notice).*** In the interim, it is recommended that CESAW issue "prudent man letters" to all the property owners and residents within the AOI advising them of the potential presence of UXO on their property and appropriate actions to take if UXO is encountered.

9.2.5 Area 4D

9.2.5.1 Area 4D (comprised of approximately 453 acres) is largely wooded and generally undeveloped. The majority of the AOI is owned by a single owner/family who has indicated he plans to retain the property for same indefinitely. The residential component is low-density with only six established residential dwellings known to exist within the AOI. In addition, this area has limited near-term development potential due to poor infrastructure and minimal frontage along primary roads. Signs of logging activities have been observed at the southern portion of the AOI. The only UXO item recovered from this AOI was a 37mm projectile recovered at a depth of 2 inches bgs. A total of 27 OE scrap items were also recovered ranging from depths from 0 to 10 inches bgs.

9.2.5.2 The findings from this EE/CA investigation, supported by archival evidence, confirm that the AOI is within a likely impact area. However, Area 4D ***does not*** fall within the boundary of an area deed-restricted for "surface use only" (see paragraph 2.3.6) following military occupation and property transfer. A number of factors were considered in the determination of the most suitable response action alternative for this AOI which included: limited public access; generally passive site activities (hunting and hiking); continuation of similar future land use; and unlikelihood

for additional residential development. ***Therefore, the implementation of site-wide Institutional Controls will provide the necessary public awareness of the former military use of Area 4D to residents and workers in the area and no removal action is warranted at this time. For the six existing homesteads identified within the AOI, a 2-acre subsurface removal action (per homestead) will be conducted encompassing the primary residential footprint***. If conditions at this AOI significantly change, re-evaluation will be conducted as part of the recurring review process (Chapter 10). In the interim, it is recommended that CESAW issue "prudent man letters" to all residents within the AOI advising them of the potential presence of UXO on their property and appropriate actions to take if UXO is encountered. Costs associated with the Area 4F residential removal action are estimated at $194,202. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance.

9.2.6 Area 4E

Area 4E is a parcel of land dedicated primarily to the farming of tobacco. Similar land use is anticipated to continue in the future. A single 37mm projectile was recovered from the AOI at 1 inch bgs as well as a single piece of OE scrap (both from the same sample grid). The AOI is located within the firing fan for the historical 37mm range, however, its orientation is adjacent to the firing point. Therefore it is unlikely that firing targets were present within Area 4E. The lack of EE/CA findings supports this assertion. Additionally, Area 4E falls almost entirely within the boundary of the area deed-restricted for "surface use only" (see paragraph 2.3.6) following military occupation and property transfer. ***Therefore, the implementation of site-wide Institutional Controls will provide the necessary public awareness of the former military use of Area 4E to residents, hunters, and workers in the area and no removal action is warranted at this time. For the five existing homesteads identified within the AOI, a 2-acre subsurface removal action (per homestead) will be conducted encompassing the primary residential footprint***. If conditions at this AOI significantly change, re-evaluation will be conducted as part of the recurring review process (Chapter 10). In the interim, it is recommended that CESAW issue "prudent man letters" to all residents within the AOI advising them of the potential presence of UXO on their property and appropriate actions to take if UXO is encountered. Costs associated with the Area 4E residential removal action are estimated at $32,367. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance.

9.2.7 Area 4

Land use in Area 4, comprised of 21,139 acres, is primarily dedicated to agriculture and forestry, with low density residential development spread along the main roads. Portions of Area 4 fall within the boundary of the areas deed-restricted for "surface use only" (see paragraph 2.3.6) following military occupation and property transfer. No UXO was recovered within the boundaries of this AOI. A total of 5 UXO items and 1118 OE scrap items were identified during the intrusive investigation. Because the majority of the AOI is privately owned, public access is limited or restricted throughout much of this

AOI. ***Therefore, the implementation of site-wide Institutional Controls will provide the necessary public awareness of the former military use of Area 4 to residents, hunters, and workers in the area and no removal action is warranted at this time. For the existing homesteads identified within the AOI (estimated to be nearly 225), a 2-acre subsurface removal action (per homestead) will be conducted encompassing the primary residential footprint***. In the interim, it is recommended that CESAW issue "prudent man letters" to all residents within the AOI advising them of the potential presence of UXO on their property and appropriate actions to take if UXO is encountered. Costs associated with the Area 4 residential removal action are estimated at $7,282,575. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance.

9.2.8 Area 5

Land use in Area 5, comprised of approximately 13,672 acres, is diverse and includes agriculture, institutional, recreational, and residential. No UXO was recovered from this AOI. A solitary OE scrap item identified as a landmine pressure plate was recovered at ground surface; however it is not considered indicative of UXO/OE presence at this AOI. Although no findings were made in support of UXO/OE presence, the most prudent response action includes the implementation of a public awareness program in Area 5. ***Therefore, the implementation of Institutional Controls (site-wide) should provide the necessary public awareness of the former military use of Area 5 to residents, hunters, and workers in the area.***

9.2.9 TCRA Lakeview USAESCH Recommendation

During the EE/CA investigation UXO was encountered within the Lakeview Subdivision. In addition, several UXO items have been reported to local officials and required military EOD response. However, the AOI ***does not*** fall within the boundary of the area deed-restricted for "surface use only" (see paragraph 2.3.6) following military occupation and property transfer. Based on the UXO findings a TCRA was conducted which removed UXO from the ground surface to a depth of six inches bgs. Considering the residential land use and the diversity of UXO and OE scrap encountered, the potential presence of residual UXO in the subsurface remains. ***Therefore, the Subsurface Clearance to Depth and Institutional Controls (site-wide) alternatives are both recommended as the OE response alternative for implementation within the Lakeview Subdivision. Digital mapping of the 26-acre site conducted following completion of the six inch removal was evaluated by USAESCH (Appendix B). USAESCH recommended an iterative removal action centered around the areas showing high residual anomaly concentrations with criteria for stopping based on lack of UXO presence. However, in order to ensure the subdivision property owner's confidence that their property is safe, investigation and removal of all anomalies within the 26-acre site is recommended.*** The estimated cost to implement the subsurface clearance alternative for the Lakeview Subdivision is $363,612. Site-wide IC costs are estimated at $80,750 with $10,500 annual maintenance.

9.2.10 MMR Divisions

As discussed in subparagraph 2.6.9, the former Camp Butner was divided into five primary ranges as part of a range inventory in the 2003 Supplemental ASR. Therefore, the summary of recommended clearance costs has been presented to coincide with these new designations. Similarly, separate Action Memorandum(s) will be prepared for each MMR range following the preparation of this Final EE/CA Report. Area 1A falls entirely within the designated "Flamethrower Range". The MMR designated "Range Complex 1" encompasses Area 4A, Area 4B, Area 4D, and Area 4E. Area 4C falls within "Range Complex 2". Area 4 falls with the confines of both Range Complex 1 and Range Complex 2.

Table 9.1
Summary of Recommended Alternatives and Clearance Costs

MMR Range /Site	Recommended Action	Clearance Acreage	Cost
FLAMETHROWER RANGE			
Site 1A	Subsurface Clearance to Depth	20	$448,618
SUBTOTAL – FLAMETHROWER RANGE			*$448,618*
RANGE COMPLEX 1			
Site 4A	Subsurface Clearance to Depth	34	$654,622
Site 4B	Subsurface Clearance to Depth (10 agricultural acres only)	10	$199,159
Site 4D	Site-Wide Institutional Controls	NA	NA
Residential	*Residential Footprint Clearance to Depth 6 Dwellings*	*12*	*$194,202*
Site 4E	Site-Wide Institutional Controls	NA	NA
Residential	*Residential Footprint Clearance to Depth 1 Dwelling*	*2*	*$32,367*
Site 4 (South of Enon)	Site-Wide Institutional Controls	NA	NA
Residential	*Residential Footprint Clearance to Depth 140 Dwellings*	*280*	*$4,531,380*
Lakeview Subdivision	Subsurface Clearance to Depth	26	$373,374
SUBTOTAL – RANGE COMPLEX 1			***$5,985,104***
RANGE COMPLEX 2			
Site 4C	Subsurface Clearance to Depth (16 acres residential only)	16	$352,999
Site 4 (North of Enon)	Site-Wide Institutional Controls	NA	NA
Residential	*Residential Footprint Clearance to Depth 85 Dwellings*	*170*	*$2,751,195*
SUBTOTAL – RANGE COMPLEX 2			***$3,104,194***

Table 9.1 (Continued)
Summary of Recommended Alternatives and Clearance Costs

MMR Range /Site	Recommended Action	Clearance Acreage	Cost
Site 5	Site-Wide Institutional Controls	NA	NA
Site-Wide IC	NA	NA	$80,750/$10,500 year
	Total		**$9,618,666 $10,500 year**

*Number of residential dwellings as of July 3, 2003 per County records.
Removal action to consist of clearance to depth for a 2-acre residential footprint around each existing dwelling. Cost is estimated at $32,367 per 2-acre residential removal, as detailed in Appendix G and in 2004 dollars.

CHAPTER 10
RECURRING REVIEWS

10.1 FOLLOW-ON ACTIVITIES

10.1.1 Follow-on activities associated with the former Camp Butner Site will be conducted by the USACE in the form of recurring reviews. The recurring review process is consistent with Section 121(c) of CERCLA, as amended by SARA, and Section 300.430 (f) (4) (ii) of the NCP. Recurring review, as outlined by these statutes, requires that periodic (at least every five years) reviews be conducted for sites where hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure following the completion of all remedial actions.

10.1.2 Recurring reviews will be conducted at the former Camp Butner Site to:

- Ensure that public health, safety, and the environment are being protected by the response actions that were implemented.
- Verify the integrity of any site controls.
- Determine if new information has become available that was not available for consideration during the EE/CA that may warrant further action.
- Determine if there is an immediate threat to the public or environment that may require an Accelerated Response.
- Review decision for Technical Impracticability to determine if new technology will address explosives safety risk.

10.1.3 The recurring review team will gather data to determine if any changes within AOIs are relevant and may affect the prior recommendations of the EE/CA. Changes to be evaluated consist of:

- Physical conditions of the AOI.
- Public accessibility and land use.
- New technology or techniques that have become available and may warrant reconsideration of the EE/CA recommendations.
- Effectiveness of the response action to reduce risk.

10.1.4 Data gathered during the review process will be used to determine if further action needs to be taken to protect public safety and the human environment. If no changes have taken place, the AOIs will continue to be monitored at the specified intervals. At the completion of the review, a Recurring Review Report will be prepared, a public notice will be placed in the local newspaper concerning the continued effectiveness of the OE response action, and a formal Decision Document referencing any actions taken will be prepared.

10.1.5 The initial recurring review will be scheduled by the government after the completion of the removal action phase to address the issues and evaluate the data as described above. The estimated cost for the site visit and review procedures is expected to be $35,000.

CHAPTER 11
REFERENCES

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