TETRA TECH FW, INC.

August 2, 2006
FWHN-FTMC-06-0032

Ms. Lydia Tadesse
Contracting Officer
US Army Engineering and Support Center, Huntsville
P.O. Box 1600
Huntsville, AL 35807

Subject: Draft Final Bravo EE/CA, Task Order 001, Modification 20, Ordnance and Explosive Response at Fort McClellan, Alabama, Contract Number DACA87-99-D-0010

Dear Ms. Tadesse:

Tetra Tech EC, Inc. is pleased to submit the Draft Final Bravo Area Engineering Evaluation/Cost Analysis of the Redevelopment Area of Fort McClellan, Alabama. Per CEHNC's request we are submitting seven copies to the Huntsville Center and fifteen copies to the Transition Force.

If you have any questions or require additional information, please contact me at (256) 830-4100.

Sincerely,

Arthur B. Holcomb, P.E.
Project Manager

Enclosures, as stated

CF: See attached distribution list.

4960 Corporate Drive Suite 140, Huntsville, Alabama 35805
TEL: 256-830-4100 FAX: 256-830-1991

TETRA TECH FW, INC.

DISTRIBUTION

ADDRESSEE	**Submittals**
Commander US Army Engineering and Support Center, Huntsville ATTN: CEHNC-OE-DC (Mr. Dan Copeland) 4820 University Square Huntsville, Alabama 35816-1822	6
Commander US Army Engineering and Support Center, Huntsville ATTN: CEHNC-CT-E (Ms. Wanda Hampton) 4820 University Square Huntsville, Alabama 35816-1822	1
Transition Force US Army Garrison ATTN: ATZN-ENV, Lisa Holstein 291 Jimmy Parks Blvd. Fort McClellan, AL 36205-500	15
Total copies	**22**

4960 Corporate Drive Suite 140, Huntsville, Alabama 35805
TEL: 256-830-4100 FAX: 256-830-1991

DEPARTMENT OF THE ARMY
HUNTSVILLE CENTER, CORPS OF ENGINEERS
P.O. BOX 1600
HUNTSVILLE, ALABAMA 35807-4301

REPLY TO
ATTENTION OF:

Design Center for Ordnance
and Explosives Directorate

Mr. Gary Harvey
Site Manager
291 Jimmy Parks Blvd.
Fort McClellan, Alabama 36205-3912

Dear Mr. Harvey:

This letter transmits the Draft-Final *Engineering Evaluation/Cost Analysis, Bravo Area of the Redevelopment Area, Fort McClellan, Alabama*, July 2006. Also enclosed are the Army's responses to comments provided September 6, 2005, by the Alabama Department of Environmental Management (ADEM) on the Engineering Evaluation/Cost Analysis and a response to information requested by ADEM during a meeting on September 7, 2005.

I certify under penalty of law that the Draft-Final *Engineering Evaluation/Cost Analysis, Bravo Area of the Redevelopment Area, Fort McClellan, Alabama*, July 2006 and the responses to the comments and the request for information were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you require additional information, please contact the undersigned at (256) 895-1567 or e-mail Daniel.D.Copeland@hnd01.usace.army.mil.

Sincerely,

Daniel D. Copeland
Contracting Officer Representative

Enclosures

Response to Item 6 from September 7, 2005 meeting minutes

During a meeting held with the Army and JPA on September 7, 2005, ADEM requested information concerning sampling protocol for the Bravo Area M3 Remainder Area–PR. Specifically, ADEM asked 1) whether the acreage is valid if only a percentage of anomalies in a given transect length or grid is intrusively investigated and 2) if acreage can be credited for visual survey of the mountain transects and grids, and if so, how would it be calculated. The U.S. Engineering and Support Center Huntsville provides the following information in response.

QuantiTech, Inc., was requested to assist in responding to ADEM's question concerning sampling protocol in the M3 Remainder Area–PR of the Bravo Area of Fort McClellan, Alabama. The question has two parts, to which the Huntsville Corps was asked to respond. The first concerned whether an acreage calculation was valid if only a percentage of the anomalies in a given transect length or grid is intrusively investigated. The second questioned if acreage can be credited toward investigation if part of the transect path width was only visually inspected.

In addressing the first question, it has been standard practice for many years to proportion the area investigated based on the percentage of anomalies investigated. As an example, if 100 anomalies are recorded in a half-acre grid (or transect) area, and only 10 of these are intrusively investigated, the area counted for investigation is judged to be 10% of 0.5 acre, or 0.05 acre. Even though the anomalies are not uniformly distributed in the grid or transect, and in many cases are not randomly distributed, this rule has proven to be conservative and workable in practice. It is generally recommended, however, where site conditions and funding allow, to intrusively investigate all anomalies. This is of course not possible in some circumstances.

The second question arose because some of the transects were credited with a 9-foot path width instead of the 5-foot width attributed to the detection ability of the instrument used. The additional 2 feet on either side of the detection swath were visually surveyed for surface ordnance during the walk. The only way this additional area could be credited is with the surface finds at the site, not including any intrusive discoveries. Therefore, the surface and intrusive anomalies would have to be separated for this type of analysis. Although this could be done, in this particular situation it is not necessary because a more than adequate amount of sampling was accomplished to satisfy the most stringent target criteria of the UXO Calculator tool used to determine the degree of field sampling required for characterization of the M3 Remainder Area-PR. In fact, a 9-foot versus 5-foot path width impacts only 3.3% of the total intrusively investigated acreage (transects plus grids).

DRAFT FINAL
Engineering Evaluation/Cost Analysis
Bravo Area
of the
Redevelopment Area
Fort McClellan, Alabama

Task Order 0001, Modification 20
Contract Number DACA87-99-D-0010

Contracting Agency:
U.S. Army Engineering and Support Center
Huntsville, Alabama

Geographical Corps District:
US Army Engineer District, Mobile

Prepared by:
Tetra Tech EC, Inc.
Fort McClellan, Alabama

July 2006

DRAFT FINAL
Engineering Evaluation/Cost Analysis
Bravo Area
of the
Redevelopment Area
Fort McClellan, Alabama

Task Order 0001, Modification 20
Contract Number DACA87-99-D-0010

Contracting Agency:
U.S. Army Engineering and Support Center
Huntsville, Alabama

Geographical Corps District:
US Army Engineer District, Mobile

Prepared by:
Tetra Tech EC, Inc.
Fort McClellan, Alabama

July 2006

Throughout the duration of this project the company now known as Tetra Tech EC, Inc has also been known by other names (i.e., Foster Wheeler Environmental Corporation and Tetra Tech FWI, Inc.). In an effort to minimize confusion when looking for particular documents/work-related information that was produced while operating under one of our previous names, we did not change the references in this document. The reference indicates the name that was in use at the time of the original work.

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision according to a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of and imprisonment for knowing violations.

Arthur B. Holcomb P.E.
Vice President

DRAFT FINAL
WORKING DOCUMENTS
SUBJECT TO CHANGE
NOT FOR RELEASE TO PUBLIC
NOT TO BE QUOTED OR REFERENCED
PROPERTY OF U.S. ARMY,
MUST BE RETURNED UPON REQUEST.

THIS PAGE INTENTIONALLY LEFT BLANK.

EXECUTIVE SUMMARY

1.0 An Engineering Evaluation/Cost Analysis (EE/CA) for the Bravo Area at Fort McClellan, Alabama, was performed to evaluate the presence of ordnance and explosives (OE) that may exist within the Bravo Area, evaluate potential risks to human health and environment due to the presence of OE, and to recommend the most technically feasible and cost-effective approach for reducing the risk associated with exposure to OE items.

2.0 This EE/CA is specific only to the Bravo Area and thus addresses only a portion of Fort McClellan. The total area covered by the Bravo EE/CA is approximately 3,325 acres. The Final Site-Specific Bravo Area Work Plan received concurrence from the Alabama Department of Environmental Management (ADEM) in a letter dated October 12, 2001. The 2004 amendment to the work plan was developed with ADEM and received ADEM concurrence in a letter dated June 29, 2004. Other areas of Fort McClellan that may have ordnance contamination are designated as Alpha, Charlie, M2 Parcel, the Eastern Bypass project area, and M1.01. Investigation and reporting on these areas will be covered under separate documents. Based on information contained in the Environmental Baseline Survey (EBS) completed for Fort McClellan (Environmental Science and Engineering, Inc. (ESE), 1998), and the Archives Search Report (ASR) (United States Army Corps of Engineers (USACE), 1999a), other areas of Fort McClellan outside of those listed above did not have any information to suggest the potential presence of unexploded ordnance (UXO)/OE to an extent that would require further investigation.

3.0 The EE/CA investigation activities were performed in a manner consistent with Section 104 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the National Oil and Hazardous Substances Pollution Contingency Plan, commonly called the "National Contingency Plan" (NCP).

4.0 This work was performed by Tetra Tech EC, Inc. (TtEC) and was authorized by the U.S. Army Engineering and Support Center Huntsville (USAESCH), under Contract DACA87-99-D-0010, Ordnance and Explosives Response Services at Fort McClellan, Task Order 0001, Modification No. 20. It should be noted that TtEC previously conducted business as Tetra Tech FW, Inc. (TtFW), and that TtFW was previously Foster Wheeler Environmental Corporation. The sampling and risk evaluation approach used for this EE/CA was developed through a series of record searches and site reconnaissance activities. The approach was presented to and approved by the Base Realignment and Closure (BRAC) Cleanup Team (BCT) in a series of meetings throughout the development of the sampling approach and implementation of the sampling activities.

5.0 The nature and extent of OE within the Bravo Area was estimated using site-specific field data collected by TtEC during the EE/CA field effort and a Field Reconnaissance. Information from Parsons Engineering Science, Inc. (Parsons) and IT Corporation collected during separate prior investigations also was used in the performance of this EE/CA. The field data was analyzed and combined with other information such as information on historical operations and topography to identify and delineate areas of potential OE contamination. Other criteria, such as current and future projected land use, was then evaluated along with the indicated OE distribution to assess the potential risk associated with the OE, and to formulate and evaluate appropriate response action alternatives.

6.0 In addition to the grids and transects sampled by TtEC within the Bravo Area, information from three other sources was also incorporated into this EE/CA. TtEC conducted a Field Reconnaissance of the 247Q (A3), A1, and A2 Areas. Only the A1 Area is within the Bravo study area. The A2 Area bounds Bravo to the south. The 247Q (A3) Area is located approximately 1 mile south of the A2 Area. The A1 Area is a 27-acre area located just south of the main cantonment area. This area was originally excluded from the Bravo EE/CA but was subsequently incorporated by direction of USAESCH. The A1 Area was combined with a sector that was already part of the Bravo and the new combined area was renamed as the A1-Reconnaissance Area-Development (D). Parsons performed sampling activities for various sites at Fort McClellan as part of a Recovered Chemical Warfare Materiels (RCWM) EE/CA (Parsons, 2002). The RCWM EE/CA included an area known as the Old Burn Pit. The Old Burn Pit was comprised of three depressions suspected to be former burn pits. These depressions were intrusively investigated during the performance of the field activities for the RCWM EE/CA, and are located in the northern portion of Bravo near Grid 587. The findings by Parsons were included in the characterization of Bravo. IT Corporation also provided information to TtEC concerning surface OE found during the performance of their Hazardous, Toxic, and Radiological Waste (HTRW) fieldwork for various locations within the Bravo Area of Fort McClellan. Findings from these sources were used to supplement the data collected by TtEC.

7.0 Fort McClellan is documented as a military training area since 1912, when the Alabama National Guard used it for artillery training. However, portions of the facility may have been used for artillery training as early as 1898 by units stationed at Camp Shipp in the Blue Mountain Area during the Spanish American War. Given the long history of ordnance training, a wide range of small arms ammunition and artillery ordnance types are present in a number of overlapping historical training areas and range firing fans.

8.0 Prior to developing the sampling plan for the EE/CA areas at Fort McClellan, TtEC performed a thorough review of documents from previous investigations and historical information. TtEC then performed a ground reconnaissance in all areas with any potential for ordnance items. Next, these areas were divided into “high”, “medium”, or “low” based on their likelihood of containing OE contamination. The Bravo Area was originally divided into ten sectors for the purposes of EE/CA sampling and characterization activities. These sectors were identified by a four character combination, with the last letter designating the probability of ordnance: L for Low, M for Medium, and H for High. The Characterization Sectors were identified as M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, M3-3H, M4-1L, M4-1M, M4-1H, and M4-2H. The first part of the name was based on the parcel name used by the Army; while the second part designated the likelihood that OE items would be present within the area. The Army and Anniston-Calhoun County FMC Development Joint Powers Authority (JPA) had divided Fort McClellan into parcels of property, designated by the letter “M” and a number, to facilitate discussions of transfer. The parcels were not developed for use in determination of where response actions would occur. The Bravo Area includes Parcels M3 and M4. Sampling activities were performed throughout these Characterization Sectors. Data collection consisted of recording surface ordnance items found in all grids, collecting geophysical data within all grids to identify subsurface geophysical anomalies, and performing intrusive sampling to determine the types of OE, OE Scrap, and Non-OE Scrap present at the site.

9.0 Following intrusive activities, the results of the site characterization and the projected land use for various areas of Bravo were reviewed. The original ten Characterization Sectors were further divided into OE Risk Assessment Sectors. The Bravo OE Risk Assessment Sectors are:

- A1-Reconnaissance Area-Development (D);
- M3-1H-Grenade Area-D;
- M3-1H-Grenade Area-Passive Reaction (PR);
- M3-1H-Mixed Use Area-D;
- M3-1H-Rocket Area-D;
- M3-1H-Rocket Area-PR;
- M3-1L-37mm Projectile Area-D;
- M3-1L-Mixed Projectile Area-PR;
- M3-Remainder Area-PR;
- M3-1L-Rocket Area-D;
- M3-1L-Suspect Area 1-PR;
- M3-1L-Suspect Area 2-PR;
- M3-2H-Mortar Area-D;
- M3-2H-Mortar Area-PR;
- M3-2M-Hand Grenade Area-PR;
- M3-3H-Rocket and Hand Grenade Area-D; and
- M4-1H-Mixed Use Area-PR.

10.0 Table ES-1 presents the original Characterization Sectors, projected future land use, and the subsequent OE Risk Assessment Sectors. A description of the process to name each sector is presented in 3.4.3.

11.0 Additional meetings between TtEC, Fort McClellan Transition Force, and the Corps of Engineers, Huntsville Center highlighted the need for additional sampling in the M3-1L Area of Bravo to further and more accurately delineate the boundaries between the areas of "High Likelihood" and "Low Likelihood" of OE present. TtEC performed additional intrusive activities in 32 selected Grids in M3-Remainder Area-PR. This sampling was conducted as Modification 12 to the existing task order. These selected grids were grids that had been geophysically mapped and some anomalies intrusively investigated during the site characterization. It was decided that all remaining primary and secondary anomalies previously identified in each of these grids would be intrusively investigated in July and August 2002. All data collected from these grids was incorporated into the existing database for the Bravo Area.

Table ES-1: Original Characterization Sectors and Final OE Risk Assessment Sectors

Characterization Sector/Assessment Area	Projected Future Land Use	OE Risk Assessment Sector
M3-1H	Eastern Bypass (D)	M3-1H-Grenade Area-D
	Active Recreation (D)	
	Retail (D)	
	Passive Recreation (PR)	M3-1H-Grenade Area-PR
	Developmental Reserve (D)	M3-1H-Mixed Use Area-D
	Retail (D)	M3-1H-Rocket Area-D
M3-1L	Developmental Reserve (D)	M3-1L-37mm Projectile Area-D
	Passive Recreation (PR)	M3-1L-Mixed Projectile Area-PR
	Passive Recreation (PR)	M3-Remainder Area-PR
	Culture (D)	M3-1L-Rocket Area-D
	Passive Recreation (PR)	M3-1L-Suspect Area 1-PR
	Passive Recreation (PR)	M3-1L-Suspect Area 2-PR
	Passive Recreation (PR)	M3-1H-Grenade Area-PR
	Mixed Business Use (D)	A-1 – Reconnaissance Area-D
M3-1M	Passive Recreation (PR)	M3-Remainder Area-PR
M3-2H	Cultural (D)	M3-2H-Mortar Area-D
	Passive Recreation (PR)	M3-2H-Mortar Area-PR
	Passive Recreation (PR)	M3-1H-Rocket Area-PR
	Eastern Bypass (D)	
M3-2M	Passive Recreation (PR)	M3-2M-Hand Grenade Area-PR
	Mixed Business Use (D)	A-1-Reconnaissance Area-D
	Development Reserve (D)	M3-3H-Rocket and Hand Grenade Area-D
M3-3H	Development Reserve (D)	M3-3H-Rocket and Hand Grenade Area-D
	Passive Recreation (PR)	M3-2M-Hand Grenade Area-PR
M4-1H	Passive Recreation (PR)	M4-1H-Mixed Use Area-PR
M4-1L	Passive Recreation (PR)	
M4-1M	Passive Recreation (PR)	
M4-2H	Passive Recreation (PR)	
M4-2H	Mixed Business Use (D)	A-1 – Reconnaissance Area-D

12.0 Supplemental sampling was also conducted in Sector M3-Remainder Area-PR in July 2004 as Modification 16 to the existing task order. The objective was to collect supplemental data to assist ADEM in their assessment of the selected risk reduction alternative proposed for this particular area. ADEM and the Army positioned supplemental transects in the mountain portions of Bravo at a meeting in February 2004. Typically, transects were placed near existing grids and transects with OE-related finds.

13.0 Alternative response actions designed to reduce the risk associated with human exposure to OE were identified. A baseline assessment of the potential risk thought to exist at each of the OE Risk Assessment Sectors was performed in accordance with USAESCH guidance documents. Because projected land use is a critical element of a human risk assessment, separate risks were evaluated for sectors that contained more than one land use within their boundary. Projected land use within the Bravo Area includes Development Reserve, Mixed Business Use, Cultural, Retail, Active Recreation, and Passive Recreation. Development Reserve, Mixed Business Use, Retail, and Cultural are categories associated with routine interaction with the

surface and near-surface soils by the employees of these facilities and during the construction of these facilities. Active Recreation land use is defined as activities associated with the development and use of facilities such as golf courses, tennis courts, swimming facilities, or ball fields. In contrast, Passive Recreation is defined as activities such as hiking, walking, bicycling, and other non-motorized activities.

14.0 For each OE Risk Assessment Sector, the risk was evaluated assuming No Further Action to be taken in that area and then assuming implementation of the five other alternatives, each of which reduces the risk of exposure to OE to some degree. This comparative evaluation resulted in a qualitative relative ranking of the effectiveness of each alternative. The alternatives included Alternative 1-No Further Action, Alternative 2-Area-Specific Land Use Controls, Alternative 3-Construction Support, Alternative 4-Surface Clearance, Alternative 5-Clearance to One Foot, and Alternative 6-Clearance to Depth.

15.0 The six response action alternatives were then evaluated against the National Contingency Plan (NCP) evaluation criteria of effectiveness, implementability, and cost. The alternatives were individually evaluated against the criteria and subsequently evaluated comparatively on a sector-specific basis, resulting in a relative ranking of alternatives for each OE Risk Assessment Sector.

16.0 Based on the consideration of all the information available, including the risk assessments and the comparative analysis of the alternatives, response action alternatives were recommended for each OE Risk Assessment Sector. These are listed in Table ES-2 and Table ES-3 (See Figure ES-1 located at the end of this chapter for sector locations). More detailed explanations and supporting rationale for each recommendation are included in Chapter 9.0 of this report.

17.0 M3-1H-Grenade Area-PR; M3-1H-Rocket Area-PR; M3-1L-Mixed Projectile Area-PR; M3-1L-Suspect Area 1-PR; M3-1L-Suspect Area 2-PR; M3-2H-Mortar Area-PR; M3-2M-Hand Grenade Area-PR; and M4-1H-Mixed Use Area-PR: The recommended alternative for all of the above listed OE Risk Assessment Sectors is Clearance to One Foot. Components of this alternative will include land surveying and brush clearing operations to prepare the site. Suitably sensitive detection instruments will be used to survey the response area and locate subsurface anomalies, which will subsequently be investigated down to 12 inches. The anomalies will then be investigated to identify them as OE, OE Scrap, or Non-OE Scrap. After identification, the item will be disposed of as scrap or OE in accordance with a previously approved OE operations work plan. The acreage and estimated cost to implement this alternative for each sector is shown in Table ES-2.

Table ES-2: Acreage and Cost for OE Risk Assessment Sector Recommended for Clearance to One Foot Sectors		
OE Risk Assessment Sector	**Area (acres)**	**Cost ($)**
M3-1H-Grenade Area-PR	86	1,834,839.00
M3-1H-Rocket Area-PR	20	482,616.00
M3-1L-Mixed Projectile Area-PR	370	6,596,447.00
M3-1L-Suspect Area 1-PR	193	3,521,129.00
M3-1L-Suspect Area 2-PR	9	251,603.00
M3-2H-Mortar Area –PR	104	2,365,189.00
M3-2M-Hand Grenade Area-PR	70	1,400,698.00
M4-1H-Mixed Use Area-PR	623	12,077,035.00
TOTAL ACREAGE AND COST	**1,475**	**28,529,556.00**

18.0 A1-Reconnaissance Area-D; M3-1H-Grenade Area-D; M3-1H-Mixed Use Area-D; M3-1H-Rocket Area-D; M3-1L-37mm Projectile Area-D; M3-1L-Rocket Area-D; M3-2H-Mortar Area-D; and M3-3H-Rocket and Hand Grenade Area-D: The recommended alternative for all of the above listed OE Risk Assessment Sectors is Clearance to Depth. Components of this alternative will include land surveying and brush clearing operations to prepare the site. Due to the requirement to detect items deeper than one foot, this alternative will be performed using sensitive instruments capable of detecting anomalies at greater depths. Using a suitable sensitive detection system, the entire response area will be surveyed to locate potential OE items. After identification, the items will be disposed of as OE or OE Scrap in accordance with a previously approved OE operations work plan. The estimated acreage and cost to implement this alternative for each sector is shown in Table ES-3.

Table ES-3: Acreage and Cost for OE Risk Assessment Sector Recommended for Clearance to Depth Sectors		
OE Risk Assessment Sector	**Area (acres)**	**Cost ($)**
A1-Reconnaissance Area-D	160	3,177,635.00
M3-1H-Grenade Area-D	31	552,068.00
M3-1H-Mixed Use Area-D	169	3,480,809.00
M3-1H-Rocket Area-D	13	355,970.00
M3-1L-37mm Projectile Area-D	180	3,440,494.00
M3-1L-Rocket Area-D	115	2,461,267.00
M3-2H-Mortar Area-D	42	1,050,647.00
M3-3H-Rocket and Hand Grenade Area-D	97	2,521,316.00
TOTAL ACREAGE AND COST	**807**	**17,040,206.00**

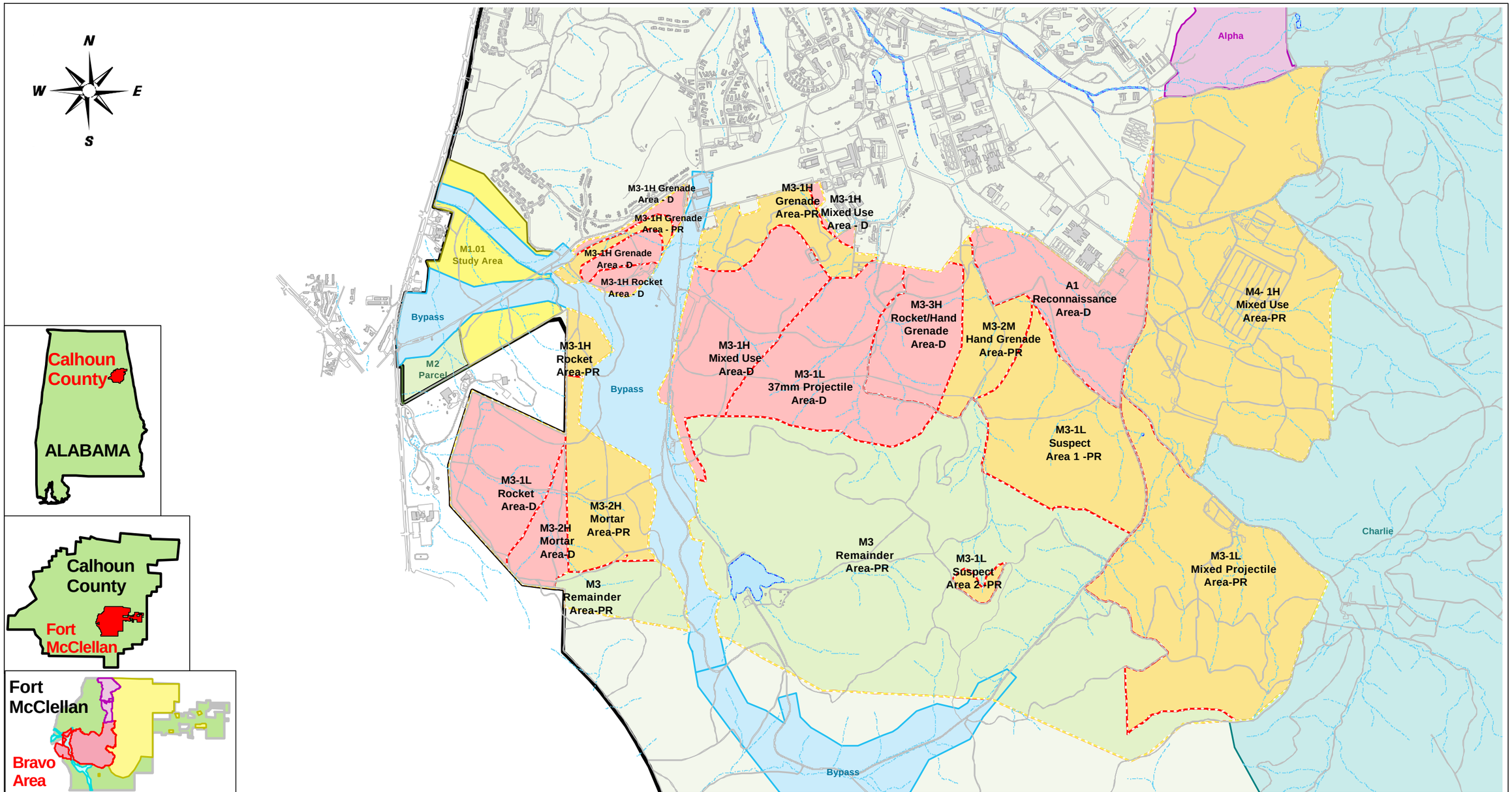
19.0 M3-Remainder Area-PR : The recommended alternative for this 1,043-acre sector is No Further Action. The estimated to implement this alternative is $5,000.

20.0 The specific actions that led to the recommended clearance actions are:

- EE/CA Investigation and data analysis;
- OE Risk Assessment;
- Development and analysis of alternatives; and
- Selection of recommended alternative for each specific area or sector.

21.0 The recommended actions have been developed in accordance with DoD 6055.9 Standard, Chapter 12, Paragraph 12.3.4.3 "Site-specific Remediation Depth Determination" and will be presented in an Action Memorandum. Approval of the Action Memorandum leads to the next phase of the OE/UXO process whereby removal actions are planned and executed. All areas recommended for removal action will be surveyed, mapped as necessary, and removals completed.

THIS PAGE INTENTIONALLY LEFT BLANK.



0 1000 2000 3000 4000 5000 6000

SCALE: 1" = 2000'

TETRA TECH EC, INC.

Legend

Bravo Sectors by Clearance Type

- Clearance To Depth
- Clearance To 1ft.
- No Further Action
- Bravo Area Boundary
- Alpha Study Area
- Charlie Study Area
- Eastern Bypass ROW Area
- M1.01 Study Area
- M2 Parcel
- Fort McClellan
- Roads
- Buildings
- Streams
- Lakes/Ponds

Figure ES-1

BRAVO AREA Projected Clearance Actions

Fort McClellan, Calhoun County, Anniston, Alabama
October 2004

TABLE OF CONTENTS

1.0 INTRODUCTION 1-1
1.1 Background 1-1
1.2 Project Authorization 1-1
1.3 Project Team Members 1-1
1.3.1 U.S. Army Engineering and Support Center, Huntsville (USAESCH) 1-1
1.3.2 U.S. Army Engineer District, Mobile 1-1
1.3.3 Tetra Tech EC, Inc. (TtEC) Corporation 1-2
1.3.4 Base Realignment and Closure (BRAC) Cleanup Team (BCT) 1-2
1.4 Purpose and Scope 1-2
1.5 EE/CA Process 1-2
1.6 Organization of Document 1-4

2.0 SITE DESCRIPTION AND HISTORY 2-1
2.1 Site Location 2-1
2.2 Physical Description 2-1
2.2.1 Geology 2-1
2.2.2 Hydrogeology 2-3
2.2.3 Topography 2-3
2.3 Site History 2-4
2.4 Demographic Profile 2-5
2.5 Current and Future Site Use 2-6
2.6 Previous Investigations 2-6
2.7 Analysis of Historical Records 2-8
2.7.1 The M4 Sectors 2-8
2.7.2 The M3 Sectors 2-13
2.8 Previous Removal Actions 2-14
2.9 Interim Removal Actions 2-14
2.9.1 Eastern Bypass (EBP) “Y” Area Junction 2-14
2.9.2 Dog Kennel Area 2-14
2.9.3 Water Tank Construction Sites 2-15

3.0 SITE CHARACTERIZATION 3-1
3.1 Geophysical Validation Plan 3-1
3.2 Quality Control 3-1
3.3 Quality Assurance 3-2
3.4 Deviations From Approved Workplans 3-2
3.5 EE/CA Investigation 3-3
3.5.1 Overview of Investigation Approach 3-4
3.5.2 Selection of Areas of Investigation 3-5
3.5.3 Determination of Sampling Acreage 3-7
3.5.4 Placement of Grids and Transects 3-8
3.5.5 OE Sampling Procedures 3-10
3.6 Source, Nature, and Extent of OE 3-20
3.6.1 Investigation Results and Findings for the Characterization Sectors 3-20
3.6.2 Identification of OE Items 3-22
3.6.3 Areas of OE Contamination 3-23

TABLE OF CONTENTS
(Continued)

4.0 ORDNANCE AND EXPLOSIVES RISK AND PROTECTIVENESS ASSESSMENT. 4-1
4.1 Introduction 4-1
4.2 Description of the Characterization Areas 4-1
4.2.1 Locations of the Characterization Areas 4-1
4.2.2 Projected Future Land Use and the Specification of OE Risk Assessment Sectors 4-3
4.2.3 Conceptual Site Models for the EE/CA Characterization and Assessment Areas 4-5
4.3 Sources of Information Used in the Risk Assessment 4-6
4.4 Summary of the Geophysical Survey and Intrusive Investigation Work in Bravo Area 4-7
4.5 The Ordnance and Explosives Risk Impact Assessment 4-8
4.5.1 Introduction 4-8
4.5.2 Performance of the OERIA Risk Assessment 4-9

5.0 INSTITUTIONAL ANALYSIS 5-1
5.1 Introduction 5-1
5.2 Purpose of the Land Use Control Assurance Plan 5-1

6.0 IDENTIFICATION OF RESPONSE ACTION OBJECTIVES 6-1
6.1 Introduction 6-1
6.2 Response Action Objectives 6-1
6.3 Applicable or Relevant and Appropriate Requirements 6-1
6.4 Discussion of Potential ARARs/TBCs 6-2
6.4.1 Chemical-Specific ARARs 6-2
6.4.2 Location-Specific ARARs 6-2
6.4.3 Action-Specific ARARs 6-3
6.4.4 Specific Requirements and TBCs 6-3
6.5 Intended Land Use 6-3

7.0 IDENTIFICATION AND ANALYSIS OF RESPONSE ACTION ALTERNATIVES .. 7-1
7.1 Description Of Alternatives 7-1
7.1.1 Alternative 1 No Further Action 7-1
7.1.2 Alternative 2 Area-Specific Land Use Controls 7-2
7.1.3 Alternative 3 Construction Support 7-2
7.1.4 Alternative 4 Surface Clearance 7-2
7.1.5 Alternative 5 Clearance to One Foot 7-2
7.1.6 Alternative 6 Clearance to Depth 7-3
7.2 Evaluation Of Alternatives 7-3
7.2.1 Effectiveness 7-3
7.2.2 Implementability 7-4
7.2.3 Cost 7-4
7.3 Effectiveness 7-4
7.3.1 Alternative 1 No Further Action 7-4

TABLE OF CONTENTS

(Continued)

7.3.2 Alternative 2 Area-Specific Land Use Controls 7-5
7.3.3 Alternative 3 Construction Support 7-5
7.3.4 Alternative 4 Surface Clearance 7-6
7.3.5 Alternative 5 Clearance to One Foot Depth 7-6
7.3.6 Alternative 6 Clearance to Depth 7-7
7.4 Implementability 7-8
7.4.1 Alternative 1 No Further Action 7-8
7.4.2 Alternative 2 Area-Specific Land Use Controls 7-8
7.4.3 Alternative 3 Construction Support 7-8
7.4.4 Alternative 4 Surface Clearance 7-9
7.4.5 Alternative 5 Clearance to One Foot Depth 7-10
7.4.6 Alternative 6 Clearance to Depth 7-10
7.5 Cost 7-11
7.5.1 Alternative 1 No Further Action 7-11
7.5.2 Alternative 2 Area-Specific Land Use Controls 7-11
7.5.3 Alternative 3 Construction Support 7-11
7.5.4 Alternative 4 Surface Clearance 7-11
7.5.5 Alternative 5 Clearance to One Foot Depth 7-11
7.5.6 Alternative 6 Clearance to Depth 7-12

8.0 A1-RECONNAISSANCE AREA-D 8-1
8.1 Description and History 8-1
8.2 Investigation Results 8-1
8.3 Description of Hazards of Specific OE Encountered 8-5
8.4 Risk Assessment 8-6
8.5 Comparative Analysis of Response Action Alternatives 8-6
8.5.1 Effectiveness 8-6
8.5.2 Implementability 8-8
8.5.3 Cost 8-9
8.6 Recommendation 8-10
8.7 Supporting Rationale 8-10

9.0 M3-1H-GRENADE AREA-D 9-1
9.1 Description and History 9-1
9.2 Investigation Results 9-1
9.3 Description of Hazards of Specific OE Encountered 9-1
9.4 Risk Assessment 9-2
9.5 Comparative Analysis of Response Action Alternatives 9-3
9.5.1 Effectiveness 9-3
9.5.2 Implementability 9-4
9.5.3 Cost 9-5
9.6 Recommendation 9-6
9.7 Supporting Rationale 9-6

TABLE OF CONTENTS
(Continued)

10.0 M3-1H-GRENADE AREA-PR 10-1
10.1 Description and History 10-1
10.2 Investigation Results 10-1
10.3 Description of Hazards of Specific OE Encountered 10-2
10.4 Risk Assessment 10-3
10.5 Comparative Analysis of Response Action Alternatives 10-4
10.5.1 Effectiveness 10-4
10.5.2 Implementability 10-4
10.5.3 Cost 10-6
10.6 Recommendation 10-6
10.7 Supporting Rationale 10-6

11.0 M3-1H-MIXED USE AREA-D 11-1
11.1 Description and History 11-1
11.2 Investigation Results 11-1
11.3 Description of Hazards of Specific OE Encountered 11-6
11.4 Risk Assessment 11-7
11.5 Comparative Analysis of Response Action Alternatives 11-8
11.5.1 Effectiveness 11-8
11.5.2 Implementability 11-9
11.5.3 Cost 11-10
11.6 Recommendation 11-11
11.7 Supporting Rationale 11-11

12.0 M3-1H-ROCKET AREA-D 12-1
12.1 Description and History 12-1
12.2 Investigation Results 12-1
12.3 Description of Hazards of Specific OE Encountered 12-4
12.4 Risk Assessment 12-5
12.5 Comparative Analysis of Response Action Alternatives 12-6
12.5.1 Effectiveness 12-6
12.5.2 Implementability 12-6
12.5.3 Cost 12-8
12.6 Recommendation 12-8
12.7 Supporting Rationale 12-9

13.0 M3-1H-ROCKET AREA-PR 13-1
13.1 Description and History 13-1
13.2 Investigation Results 13-1
13.3 Description of Hazards of Specific OE Encountered 13-1
13.4 Risk Assessment 13-2
13.5 Comparative Analysis of Response Action Alternatives 13-2
13.5.1 Effectiveness 13-2
13.5.2 Implementability 13-3

TABLE OF CONTENTS
(Continued)

13.5.3 Cost 13-5
13.6 Recommendation 13-5
13.7 Supporting Rationale 13-5

14.0 M3-1L-37MM PROJECTILE AREA-D 14-1
14.1 Description and History 14-1
14.2 Investigation Results 14-1
14.3 Description of Hazards of Specific OE Encountered 14-1
14.4 Risk Assessment 14-3
14.5 Comparative Analysis of Response Action Alternatives 14-3
14.5.1 Effectiveness 14-3
14.5.2 Implementability 14-4
14.5.3 Cost 14-6
14.6 Recommendation 14-6
14.7 Supporting Rationale 14-6

15.0 M3-1L-MIXED PROJECTILE AREA-PR 15-1
15.1 Description and History 15-1
15.2 Investigation Results 15-1
15.3 Description of Hazards of Specific OE Encountered 15-1
15.4 Risk Assessment 15-4
15.5 Comparative Analysis of Response Action Alternatives 15-4
15.5.1 Effectiveness 15-4
15.5.2 Implementability 15-5
15.5.3 Cost 15-6
15.6 Recommendation 15-7
15.7 Supporting Rationale 15-7

16.0 M3-REMAINDER AREA-PR 16-1
16.1 Description and History 16-1
16.2 Investigation Results 16-1
16.3 Description of Hazards of Specific OE Encountered 16-7
16.4 Risk Assessment 16-7
16.5 Comparative Analysis of Response Action Alternatives 16-8
16.5.1 Effectiveness 16-8
16.5.2 Implementability 16-9
16.5.3 Cost 16-11
16.6 Recommendation 16-11
16.7 Supporting Rationale 16-11

17.0 M3-1L-ROCKET AREA-D 17-1
17.1 Description and History 17-1
17.2 Investigation Results 17-1
17.3 Description of Hazards of Specific OE Encountered 17-2
17.4 Risk Assessment 17-3
17.5 Comparative Analysis of Response Action Alternatives 17-3
17.5.1 Effectiveness 17-3

TABLE OF CONTENTS
(Continued)

17.5.2 Implementability 17-4
17.5.3 Cost 17-5
17.6 Recommendation 17-6
17.7 Supporting Rationale 17-6

18.0 M3-1L-SUSPECT AREA 1-PR 18-1
18.1 Description and History 18-1
18.2 Investigation Results 18-1
18.3 Description of Hazards of Specific OE Encountered 18-1
18.4 Risk Assessment 18-6
18.5 Comparative Analysis of Response Action Alternatives 18-7
18.5.1 Effectiveness 18-7
18.5.2 Implementability 18-8
18.5.3 Cost 18-9
18.6 Recommendation 18-9
18.7 Supporting Rationale 18-10

19.0 M3-1L-SUSPECT AREA 2-PR 19-1
19.1 Description and History 19-1
19.2 Investigation Results 19-1
19.3 Description of Hazards of Specific OE Encountered 19-1
19.4 Risk Assessment 19-2
19.5 Comparative Analysis of Response Action Alternatives 19-2
19.5.1 Effectiveness 19-2
19.5.2 Implementability 19-3
19.5.3 Cost 19-5
19.6 Recommendation 19-5
19.7 Supporting Rationale 19-5

20.0 M3-2H-MORTAR AREA-D 20-1
20.1 Description and History 20-1
20.2 Investigation Results 20-1
20.3 Description of Hazards of Specific OE Encountered 20-3
20.4 Risk Assessment 20-3
20.5 Comparative Analysis of Response Action Alternatives 20-3
20.5.1 Effectiveness 20-3
20.5.2 Implementability 20-4
20.5.3 Cost 20-5
20.6 Recommendation 20-6
20.7 Supporting Rationale 20-6

21.0 M3-2H-MORTAR AREA-PR 21-1
21.1 Description and History 21-1
21.2 Investigation Results 21-1
21.3 Description of Hazards of Specific OE Encountered 21-3
21.4 Risk Assessment 21-3
21.5 Comparative Analysis of Response Action Alternatives 21-3

TABLE OF CONTENTS
(Continued)

21.5.1 Effectiveness 21-3
21.5.2 Implementability 21-4
21.5.3 Cost 21-5
21.6 Recommendation 21-6
21.7 Supporting Rationale 21-6

22.0 M3-2M-HAND GRENADE AREA-PR 22-1
22.1 Description and History 22-1
22.2 Investigation Results 22-1
22.3 Description of Hazards of Specific OE Encountered 22-2
22.4 Risk Assessment 22-3
22.5 Comparative Analysis of Response Action Alternatives 22-3
22.5.1 Effectiveness 22-3
22.5.2 Implementability 22-4
22.5.3 Cost 22-6
22.6 Recommendation 22-6
22.7 Supporting Rationale 22-6

23.0 M3-3H-ROCKET/HAND GRENADE AREA-D 23-1
23.1 Description and History 23-1
23.2 Investigation Results 23-1
23.3 Description of Hazards of Specific OE Encountered 23-6
23.4 Risk Assessment 23-7
23.5 Comparative Analysis of Response Action Alternatives 23-8
23.5.1 Effectiveness 23-8
23.5.2 Implementability 23-8
23.5.3 Cost 23-10
23.6 Recommendation 23-10
23.7 Supporting Rationale 23-11

24.0 M4-1H-MIXED USE AREA-PR 24-1
24.1 Description and History 24-1
24.2 Investigation Results 24-1
24.3 Description of Hazards of Specific OE Encountered 24-10
24.4 Risk Assessment 24-11
24.5 Comparative Analysis of Response Action Alternatives 24-12
24.5.1 Effectiveness 24-12
24.5.2 Implementability 24-13
24.5.3 Cost 24-14
24.6 Recommendation 24-15
24.7 Supporting Rationale 24-15

25.0 RECURRING REVIEWS 25-1
25.1 Follow-On Activities 25-1

26.0 REFERENCES 26-1

TABLE OF CONTENTS
(Continued)

List of Appendices

Appendix A	Contract Documents
	Statement of Work, Modification 20
	ADEM Approval Letter
	Memorandum with Munitions Response Terminology
Appendix B	Figures of Bravo Area
	Figure B-1: Bravo Area Ranges and Impact Areas
	Figure B-2: Bravo Area EE/CA Overview
Appendix C	Field Reconnaissance Report of the 247Q (A3), A1, and A2 Areas
Appendix D	Geophysical Validation Plan
Appendix E	Quality Assurance Audit Evaluation
Appendix F	Intrusive Results
	Table of All Findings
	Table of Findings from Parsons CWM EE/CA
	Table of Audible Signals from Original Bravo Mountain Transects
	Anomalies (Digs) in Supplemental Transects
	Eastern Bypass 40mm Finding Information
	Logbooks for Supplemental Mountain Transects
Appendix G	Land Use Control Assurance Plan (LUCAP)
Appendix H	Cost Analysis

TABLE OF CONTENTS
(Continued)

List of Figures

Figure 1-1 EE/CA Study Area 1-5
Figure 2-1 Bravo Area EE/CA Study Area 2-17
Figure 2-2 Bravo Area Geology 2-19
Figure 2-3 Water Tank Construction Sites 2-21
Figure 3-1 Fragmentation Zone for an 81mm 3-25
Figure 3-2 Conceptual Impact Area for an 81mm 3-27
Figure 3-3: Bravo Area Sampling Procedures and Figure Symbology 3-29
Figure 3-4 Example of a Geophysical Grid Map 3-31
Figure 4-1 Bravo Area Projected Land Use 4-25
Figure 8-1 A1-Reconnaissance Area-D Conceptual Site Model 8-11
Figure 8-2 OERIA Table for Sector A1-Reconnaissance Area-D 8-12
Figure 9-1 M3-1H-Grenade Area-D Conceptual Site Model 9-7
Figure 9-2 OERIA Table for Sector M3-1H-Grenade Area-D 9-8
Figure 10-1 M3-1H-Grenade Area-PR Conceptual Site Model 10-9
Figure 10-2 OERIA Table for Sector M3-1H-Grenade Area-PR 10-10
Figure 11-1 M3-1H-Mixed Use Area-D Conceptual Site Model 11-13
Figure 11-2 OERIA Table for Sector M3-1H-Mixed Use Area-D 11-14
Figure 12-1 M3-1H-Rocket Area-D Conceptual Site Model 12-11
Figure 12-2 OERIA Table for Sector M3-1H-Rocket Area-D 12-12
Figure 13-1 M3-1H-Rocket Area-PR Conceptual Site Model 13-7
Figure 13-2 OERIA Table for Sector M3-1H-Rocket Area-PR 13-8
Figure 14-1 M3-1L-37mm Projecti1e Area-D Conceptual Site Model 14-7
Figure 14-2 OERIA Table for Sector M3-1L-37mm Projectile Area-D 14-8
Figure 15-1 M3-1L-Mixed Projectile Area-PR Conceptual Site Model 15-9
Figure 15-2 OERIA Table for Sector M3-1L-Mixed Projectile Area-PR 15-10
Figure 16-1 M3-Remainder Area–PR Conceptual Site Model 16-13
Figure 16-2 OERIA Table for Sector M3-Remainder Area-PR 16-14
Figure 16-3 OERIA Table for Sector M3-Remainder Area-R 16-15
Figure 17-1 M3-1L Rocket Area-D Conceptual Site Model 17-7
Figure 17-2 OERIA Table for Sector M3-1L-Rocket Area-D 17-8
Figure 18-1 M3-1L-Suspect Area 1-PR Conceptual Site Model 18-11
Figure 18-2 OERIA Table for Sector M3-1L-Suspect Area 1-PR 18-12
Figure 19-1 M3-1L-Suspect Area 2-PR Conceptual Site Model 19-7
Figure 19-2 OERIA Table for Sector M3-1L-Suspect Area 2 -PR 19-8
Figure 20-1 M3-2H-Mortar Area-D Conceptual Site Model 20-7
Figure 20-2 OERIA Table for Sector M3-2H-Mortar Area -D 20-8
Figure 21-1 M3-2H-Mortar Area-PR Conceptual Site Model 21-7
Figure 21-2 OERIA Table for Sector M3-2H-Mortar Area-PR 21-8
Figure 22-1 M3-2M-Hand Grenade Area-PR Conceptual Site Model 22-9
Figure 22-2 OERIA Table for Sector M3-2M-Hand Grenade Area-PR 22-10
Figure 23-1 M3-3H-Rocket/Hand Grenade Area-D Conceptual Site Model 23-13
Figure 23-2 OERIA Table for Sector M3-3H-Rocket/Hand Grenade Area-D 23-14
Figure 24-1 M4-1H-Mixed Use Area-PR Conceptual Site Model 24-17
Figure 24-2 OERIA Table for Sector M4-1H-Mixed Use Area-PR 24-18

TABLE OF CONTENTS
(Continued)

List of Tables

Table 2-1 Summary of Major Stratigraphic Units 2-2
Table 2-2 Ordnance and Explosives Historically Associated with the Bravo Area 2-10
Table 3-1 Process for Placement of Supplemental Transects 3-18
Table 3-2 Anomalies (Digs) in Supplemental Transects 3-22
Table 4-1 Ordnance and Explosives Risk Assessment Sectors 4-5
Table 4-2 Area Geophysically Surveyed and Intrusively Investigated in Each OE Risk Assessment Sector 4-7
Table 4-3 The Basic OERIA Risk Factors 4-9
Table 4-4 OE Categories with Descriptions 4-13
Table 4-5 Category Descriptions and Assignment Rules for the OE Sensitivity Risk Factor 4-14
Table 4-6 Category Descriptions for the OE Site Access Level 4-15
Table 4-7 Category Descriptions for OE Site Stability 4-15
Table 4-8 Category Descriptions for the OE Contact Probability Level 4-16
Table 4-9 Response Action Alternatives Addressed in the Risk Assessment 4-18
Table 4-10 Overall Protectiveness Ranking for the Candidate Response Action Alternatives for Each Bravo OE Risk Assessment Sector 4-20
Table 6-1 List of Potential Applicable or Relevant and Appropriate Requirements To Be Considered 6-4
Table 8-1 List of OE and OE Scrap Found in A1-Reconnaisance Area-D 8-2
Table 9-1 List of OE and OE Scrap Found in M3-1H Grenade Area-D 9-2
Table 10-1 List of OE and OE Scrap Items Found in M3-1H Grenade Area-PR 10-2
Table 11-1 List of OE and OE Scrap Items Found in M3-1H Mixed Use Area-D 11-2
Table 12-1 List of OE and OE Scrap Items Found in M3-1H Rocket Area-D 12-2
Table 13-1 List of OE Scrap Items Found in M3-1H Rocket Area-PR 13-2
Table 14-1 List of OE and OE Scrap Items Found in M3-1L 37mm Projectile Area-D 14-2
Table 15-1 List of OE and OE Scrap Items Found in M3-1L Mixed Projectile Area-PR 15-2
Table 16-1 List of OE Scrap Items Found in M3-Remainder Area-PR 16-3
Table 16-2 Anomalies (Digs) in Supplemental Transects 16-7
Table 16-3 Rationale for Placement of Supplemental Transects 16-12
Table 17-1 List of OE and OE Scrap Items Found in M3-1L Rocket Area-D 17-2
Table 18-1 List of OE and OE Scrap Items Found in M3-1L Suspect Area 1-PR 18-2
Table 19-1 List of OE and OE Scrap Items Found in M3-1L Suspect Area 2-PR 19-1
Table 20-1 List of OE and OE Scrap Items Found in M3-2H Mortar Area-D 20-2
Table 21-1 List of OE and OE Scrap Items Found in M3-2H Mortar Area-PR 21-2
Table 22-1 List of OE and OE Scrap Items Found in M3-2M Hand Grenade Area-PR 22-2
Table 23-1 List of OE and OE Scrap Items Found in M3-3H Rocket/Hand Grenade Area-D 23-2
Table 24-1 List of OE and OE Scrap Items Found in M4-1H Mixed Use Area-PR 24-2

ACRONYMS

1D	one dimensional
2D	two dimensional
ADEM	Alabama Department of Environmental Management
ALDOT	Alabama Department of Transportation
APC	Armor Piercing Capped
APT	Armor Piercing Tracer
AR	Army Regulation
ARARs	Applicable or Relevant and Appropriate Requirements
ASR	Archives Search Report
BCT	BRAC Cleanup Team
BRAC	Base Realignment and Closure
BWM	Biological Warfare Materiel
CAIS	chemical agent identification set
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
D	Development
DA	Department of the Army
DDESB	Department of Defense Explosives Safety Board
DERP	Defense Environmental Restoration Program
DID	Data Item Description
DoD	Department of Defense
EBP	Eastern Bypass
EBS	Environmental Baseline Survey
EE/CA	Engineering Evaluation/Cost Analysis
EOD	Explosive Ordnance Disposal
EODT	Explosive Ordnance Disposal Team
EPA	Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ESE	Environmental Science and Engineering, Inc.
ESS	Explosives Safety Submission
FFE	flame field expedients
FMC	Fort McClellan
FUDS	formerly used Defense Site
FWS	U.S. Fish and Wildlife Service
GIS	Geographical Information System
GPO	Geophysical Prove-Out
GPS	Geographic Positioning System
H	High OE Density
HE	High Explosive
HEAT	High Explosive Anti-Tank
HH	hand-held
HTRW	Hazardous Toxic and Radiological Waste
in	Inch
JPA	Anniston-Calhoun County FMC Development Joint Powers Authority
L	Low OE Density
LE	Low Explosive

ACRONYMS

LUCAP	Land Use Control Assurance Plan
LUCIP	Land Use Control Implementation Plan
LUCs	Land Use Controls
M	Medium OE Density
MCX	Mandatory Center of Expertise
mm	Millimeter
MOA	Memorandum of Agreement
MPM	Most Probable Munitions
msl	mean sea level
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
OE	Ordnance and Explosives
OERIA	Ordnance and Explosives Risk Impact Assessment
ORNL	Oak Ridge National Laboratory
PD	point detonation
PIBD	point initiating base detonating
PM	Project Manager
PR	Passive Recreation
R	Residential
RCRA	Resource Conservation and Recovery Act
RCWM	Recovered Chemical Warfare Materiel
RMS	Root Mean Squared
SOW	Statement of Work
SRs	stationary receivers
SUXOS	Senior UXO Supervisor
TBC	to be considered
TNT	trinitrotoluene
TPT	Target Practice with Tracer
TRADOC	United States Army Training and Doctrine Command
TtEC	Tetra Tech EC, Inc,
TtFW	Tetra Tech FW, Inc.
USACE	U. S. Army Corps of Engineers
USAESCH	U. S. Army Corps of Engineers, Engineering and Support Center, Huntsville
USRADS	Ultra-Sonic Ranging and Data System
UXO	Unexploded Ordnance
WP	White Phosphorous
WWI	World War I
WWII	World War II

DEFINITIONS

Ammunition: A generic term related mainly to articles of military application consisting of all kinds of bombs, grenades, rockets, mines, projectiles, and other similar devices or contrivances (TB 700-2/NAVSEAINST 8020.8B/TO 11A-1-47/DLAR 8220.1).

Anomaly: Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and non-ferrous material at the site (i.e., pipes, power lines, etc.) (EP 1110-1-18) (USACE, 2000).

Applicable or Relevant and Appropriate Requirements (ARARs): Applicable requirements are cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under federal or state environmental law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance found at a CERCLA site. Relevant and appropriate requirements are cleanup standards that while not "applicable", address situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site (USACE, 2000).

Archives Search Report (ASR): A detailed investigation to report on past OE activities conducted on an installation. The principal purpose of the Archives Search Report is to assemble historical records and available field data, assess potential ordnance presence, and recommend follow-up actions at a Defense Environmental Restoration Program (DERP) - formerly used Defense Site (FUDS). There are four general steps in an Archives Search: records search phase, site safety and health plan, site survey, archives search report including risk assessment (USACE, 2000).

Clearance to Depth: Response action alternative that includes the surface and subsurface clearance of OE items to a depth corresponding to the maximum depth of OE encountered in each sector. Under this alternative, investigation (i.e., excavation) of an anomaly (i.e., suspect OE item) will continue until the source of the anomaly is found, or until it is determined that no OE item is present. This alternative was developed in accordance with DoD 6055.9 Standard, Chapter 12, Paragraph 12.3.4.3 “Site-specific Remediation Depth Determination”.

Clearance to One Foot: Response action alternative that includes the surface and subsurface clearance of OE items to a depth of one foot. The depth of one-foot was selected based on site-specific information, future land use, and type of ordnance items that have been found in the vicinity and that may be present within the study area, and typical penetration depths for the types of OE items that may be present. Implementation of this alternative will require land surveying and brush clearing operations to prepare the site. This alternative will include a deed restriction that prohibits digging below one foot in the study area without construction support by UXO-qualified personnel. This alternative was developed in accordance with DoD 6055.9 Standard, Chapter 12, Paragraph 12.3.4.3 “Site-specific Remediation Depth Determination.”

Construction Support: Response action alternative that reduces accidental exposure within construction footprint areas. Involves support provided by qualified UXO personnel during construction activities at potential OE sites to ensure the safety of construction personnel from

the harmful effects of UXO. When a determination is made that the probability of encountering UXO is low (e.g., current or previous land use leads to an initial determination that OE may be present), a minimum of a two person UXO team will stand by in case the construction contractor encounters a suspected UXO. When a determination is made that the probability of encountering a UXO is moderate to high (current or previous land use leads to a determination that OE was employed or disposed of in the parcel of concern, e.g., open burn and open detonation areas, maneuver areas, etc.), UXO teams are required to conduct subsurface UXO clearance for the known construction footprint either in conjunction with the construction contractor or prior to construction intrusive activities. The level of effort will be determined on a case-by-case basis in coordination with the OE Mandatory Center of Expertise (MCX) (ER 1110-1-8153) (USACE, 2000).

Conventional Ordnance and Explosives: The term "conventional OE refers to ordnance and explosives (see definition) other than RCWM, Biological Warfare Materiel (BWM) and nuclear ordnance (ER 1110-1-8153) (USACE, 2000).

Detonator: A device capable of inducing a high-order detonation in high explosives (TM60A-1-1-31).

Explosive: A material, either a pure single substance or mixture of substances, which is capable of producing an explosion by its own energy (TM 60A-1-1-9).

Explosive Ordnance Disposal (EOD): The detection, identification, field evaluation, rendering safe, recovery, and final disposal of unexploded ordnance or munitions (EP 1110-1-18) (USACE, 2000).

Explosives Safety Submission (ESS): The document that serves as the specifications for safely conducting work activities at the project. The ESS details the scope of the project, the planned work activities, and potential hazards (including the maximum credible event) and the methods for their control (EP 1110-1-18) (USACE, 2000).

Fragment: A piece of an exploding or exploded munition. Fragments may be complete items, subassemblies, pieces thereof or pieces of equipment or buildings containing the items (DA PAM 385-64).

Fuze: A mechanical, electrical, or electromechanical device used to function an explosive device such as a bomb or projectile (TM 60A-1-1-31).

High Explosive: An explosive, which once initiated, normally produces a detonation (TM-60A-1-1-9).

Intrusive Investigation: The act of excavating suspected UXO items or plotted anomalies.

Land Use Controls: Response action alternative that does not involve removal or destruction of OE. This alternative controls potential exposure to OE through signs, fencing, education, etc.

No Further Action: The No Further Action alternative requires No Further Action at the site. This alternative was evaluated for each sector as a baseline.

Non-Intrusive Investigation: The process of locating subsurface UXO by use of magnetometers or geophysical survey equipment without digging or otherwise disturbing the medium being surveyed.

Ordnance and Explosives (OE): Ammunition, ammunition components, chemical or biological warfare materiel or explosives that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried, or fired. Such ammunition, ammunition components, and explosives are no longer under accountable record control of any DOD organization or activity. (HQDA Policy Memorandum "Explosives Safety Policy for Real Property Containing Conventional OE") (ER 1110-1-8153) (USACE, 2000).

OE Scrap: Parts of previous OE or OE related items that functioned as designed, but do not contain an explosive hazard, or that could not be positively identified.

Practice Ammunition: Ammunition or ammunition components used for training. Practice ammunition simulates a service item in weight, design, and ballistic properties. A practice round may be inert or have a small quantity of explosive filler used as a spotting charge (DA PAM 385-64).

Recovered Chemical Warfare Materiel (RCWM): An item configured as a munition containing a chemical substance that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. Also includes V- and G- series nerve agent, H- series blister agent, and lewisite in other- than-munition configurations. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered RCWM. RCWM does not include: riot control agents, chemical herbicides; smoke and flame producing items; or soil, water, debris, or other media contaminated with chemical agent (HQDA Interim Guidance for Biological Warfare Materiel and Non-Stockpile Recovered Chemical Warfare Materiel Response Activities) (USACE, 2000).

Small Arms Ammunition: Ammunition items up to and including a 20mm (DA PAM 385-64).

Surface Clearance: Response action alternative that involves the removal of surface OE from the site. The area is divided into investigation grids and a visual search (aided by the hand-held metal detection instruments) conducted by UXO personnel walking through each grid, visually scanning the surface for OE. This alternative will include a deed restriction that prohibits digging in the study area without construction support by UXO-qualified personnel.

Training Ammunition: Consists of those stocks designed for training military units and may include practice ammunition, and “dummy” ammunition (ammunition with no explosives or propellants). Note that practice ammunition is a definition of designated function for a specific item, whereas training ammunition is a category of intended use for ammunition.

Unexploded Ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause (40 CFR 266.20 1) (USACE, 2000).

UXO Personnel: Contractor personnel who have completed specialized military training in EOD methods and have satisfactorily performed the EOD function while serving in the military. Various grades and contract positions are established based on skills and experience. Check with the OE MCX for current ratings (ER 1110-1-8153) (USACE, 2000).

1.0 INTRODUCTION

1.1 BACKGROUND

This Engineering Evaluation/Cost Analysis (EE/CA) for the Bravo portion of the Redevelopment Area at Fort McClellan was performed under the Base Realignment and Closure (BRAC) Program. This EE/CA is specific to the Bravo Area and thus addresses only a portion of Fort McClellan. The total area covered by the Bravo EE/CA is approximately 3,325 acres. Other areas of Fort McClellan that may have ordnance contamination are designated as Alpha, Charlie, Area M1.01, Area M2, and the Eastern Bypass. See Figure 1-1, located at the end of this chapter, for the areas investigated at Fort McClellan. The Bravo EE/CA Work Plan received concurrence from the Alabama Department of Environmental Management (ADEM) by letter dated October 12, 2001 (See Appendix A). The 2004 amendment to the Work Plan was developed with ADEM and received ADEM concurrence in a letter dated June 29, 2004. Federal law requires that government facilities, subject to closure and subsequent reuse, be subject to remediation. Activities conducted in support of this project were conducted in a manner consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

1.2 PROJECT AUTHORIZATION

The United States Army Engineering and Support Center, Huntsville (USAESCH) Ordnance and Explosives Design Center has a mission "to safely eliminate or reduce risks from ordnance, explosives and recovered chemical warfare materiel at current or formerly used defense sites." As part of its effort to fulfill this mission, USAESCH has contracted Tetra Tech EC, Inc (TtEC) (under Contract DACA 87-99-D-0010, Task Order 0001, Modification 20, dated January 24, 2006) to perform an Engineering Evaluation/Cost Analysis (EE/CA) for the Bravo portion of the Redevelopment Area at Fort McClellan. TtEC previously conducted operations as Tetra Tech FW, Inc. (TtFW) and TtFW was previously Foster Wheeler Environmental Corporation. Appendix A contains the Statement of Work for this EE/CA.

1.3 PROJECT TEAM MEMBERS

1.3.1 U.S. Army Engineering and Support Center, Huntsville (USAESCH)

The USAESCH is the implementing agency responsible for the execution of this project. Responsibilities include procurement of services, providing direction to the prime contractor, approving the budget and schedule, and coordination of document reviews by other agencies.

1.3.2 U.S. Army Engineer District, Mobile

The U.S. Army Corps of Engineers, Mobile District, is the Project Manager (PM) for this project.

1.3.3 Tetra Tech EC, Inc. (TtEC) Corporation

TtEC is the prime contractor to USAESCH and provides all engineering support and services for the project. TtEC is responsible for performance of the activities detailed in the Statement of Work (SOW) as well as control of the project schedule and budget.

1.3.4 Base Realignment and Closure (BRAC) Cleanup Team (BCT)

The BCT is comprised of stakeholders of former Fort McClellan, including the Transition Force Environmental Office, ADEM, the US Environmental Protection Agency (EPA), and the United States Army Corps of Engineers (USACE). The goal of the BCT is to reach mutually acceptable solutions to environmental problems at Fort McClellan for all stakeholders and to provide direction for remediation of any environmental problems.

1.4 PURPOSE AND SCOPE

Fort McClellan was a former United States Army Training and Doctrine Command (TRADOC) facility that was closed in September 1999 under the BRAC Program. The primary use of Fort McClellan has been for troop training (e.g., artillery, small arms, chemical warfare training) and mobilization activities.

1.4.1 The purpose of this EE/CA is to:

- Identify the nature and extent of ordnance and explosive (OE) contamination within each Bravo sector;
- Evaluate the effectiveness of various response action alternatives in reducing risks;
- Assess the ability to implement various response action alternatives;
- Determine the cost to implement the applicable response action alternatives; and
- Evaluate and determine the most appropriate and preferred alternative.

1.4.2 The objectives of this EE/CA are to:

- Determine the amount, type, and general location of ordnance and explosives (OE) within the Bravo Portion of the Redevelopment Area;
- To evaluate the potential risks to human health and the environment due to the presence of OE; and
- To assess and recommend the most technically feasible and cost-effective approach for reducing the risk of exposure to OE.

1.5 EE/CA PROCESS

The EE/CA process includes evaluating all archival data; conducting initial visual field reconnaissance; geophysical mapping; and intrusive field investigations to characterize the type, distribution, and extent of OE items within the boundaries of the site; and analysis of the field investigation data to determine the risks associated with the current and proposed future uses of

the property. TtEC characterized the area designated as the Bravo portion of Fort McClellan through Grids, Data Collection Transects, Delineation Transects, and Mountain Transects. Grids were typically 100 foot by 100 foot areas that are fully walked for data collection. Grids are placed throughout a sector for characterization. Each Data Collection Transect consisted of a series of 200-foot long, parallel segments spaced 25 to 50-feet wide. The segments were established and then fully investigated. Delineation transects were used to further define areas of high OE concentration. Delineation Transects are basically straight segments approximately 3.5 feet wide of varying length. Several Delineation Transects would be established in a particular area in a north-south and east-west grid-like pattern and walked for data collection. Mountain transects were laid out in areas with slopes greater than 40 degrees. Transects were placed in order to achieve a wide geographic distribution across mountainsides that may have been used as backstops for artillery firing. The initial mountain transect paths were 15 feet wide, and generally followed contours across the flanks of the mountains, (mountain transects T01-T24) with one to three transects placed across each significant mountainside. Supplemental mountain transects (mountain transects T25-T65) were 5 feet wide and each segment was 290 feet long.

1.5.1 Following the field investigation activities, response action alternatives were developed and evaluated. Response action alternatives were developed according to DoD 6055.9 Standard, Chapter 12, Paragraph 12.3.4.3 "Site-specific Remediation Depth Determination". This process requires consideration of types and distribution of OE and UXO, depths of UXO, and proposed land reuse in making final remedy selections. Six alternatives were developed for the Bravo Area EE/CA: Alternative 1–No Further Action; Alternative 2–Area-Specific Land Use Controls; Alternative 3–Construction Support; Alternative 4–Surface Clearance; Alternative 5–Clearance to One Foot; Alternative 6–Clearance to Depth (See "Definitions" for a description of these alternatives). The EE/CA Report is prepared and processed through a series of draft iterations. Prior to finalizing the EE/CA Report, a public comment period and public meeting will be scheduled. This will satisfy the EE/CA process.

1.5.2 Once the EE/CA Report has addressed any comments generated during the public review period and is approved, an Action Memorandum will be prepared. The Action Memorandum will be the decision document of record that provides the authority and direction to conduct the approved response action. The Action Memorandum will be based on the information provided by the EE/CA, and will be equivalent to the Record of Decision used for National Priorities List (NPL) sites. Following this decision process, Alternatives are performed in accordance with the recommendations from the Action Memorandum. An alternative action is the set of processes and activities to accomplish the on site response actions necessary to complete the removal of the OE/UXO from the site, with a final report of all actions completed during the removal process to include quality control and quality assurance of the processes and the data. Response actions cover all acreage designated for a removal, to include the areas previously investigated during the EE/CA process. A Response Action may entail destruction of the individual ordnance items(s) in place, when the danger of moving the item is greater than destruction on site. Response Action may also entail instituting other protective measures such as fencing, land use restrictions, and public education programs. If, during implementation of the alternative(s) in accordance with the Action Memorandum, unanticipated items are discovered that are not adequately addressed by the response action, additional response action alternatives and/or land use controls may be required. Post-removal Actions include Recurring Reviews, Long-Term Monitoring of the site, continuing public education about the former

military use of the site and the potential for OE and UXO to still occur in the area, deed notices about the former military use of the land, and Land Use Restrictions to prohibit digging below a specified depth in a former OE area without qualified UXO technician support where necessary. These are required to continue after the removal response phase has been completed.

1.5.3 The *Memorandum for the Assistant Chief of Staff for Installation Management,* dated April 21, 2005 defines the new Munitions Response Terminology. This memorandum is located in Appendix A of this report. This project was initiated prior to issuance of the memorandum and uses the previously accepted munitions terminology.

1.6 ORGANIZATION OF DOCUMENT

The format of this EE/CA report follows the requirements in Data Item Description (DID) OE-10. The organization of this report and the contents of each section are as follows:

- **Chapter 1.0 :** Provides an introduction to the report, including background information on Bravo, the purpose and organization of the report, and a description of the EE/CA process.
- **Chapter 2.0 :** Provides a detailed site description and history of Fort McClellan including site location, physical description, demographic profile, current and future land use, and previous investigations and removal actions.
- **Chapter 3.0 :** Summarizes the site characterization conducted in Bravo. This chapter includes details of the EE/CA investigation and the source, nature, and extent of OE contamination.
- **Chapter 4.0 :** Presents the ordnance and explosives risk and protectiveness assessment.
- **Chapter 5.0 :** Provides an institutional analysis.
- **Chapter 6.0 :** Identifies the response action objectives.
- **Chapter 7.0** : Identifies and analyzes the response action alternatives.
- **Chapters 8.0 through 24.0**: Provides sector-specific site characterization summaries, analysis, and remedial response recommendations.
- **Chapter 25.0:** Summarizes the requirements of recurring reviews.
- **Chapter 26.0:** Lists references used in preparing this report.
- **Appendices A through H:** Provide detailed data supporting the recommendations presented in this report.

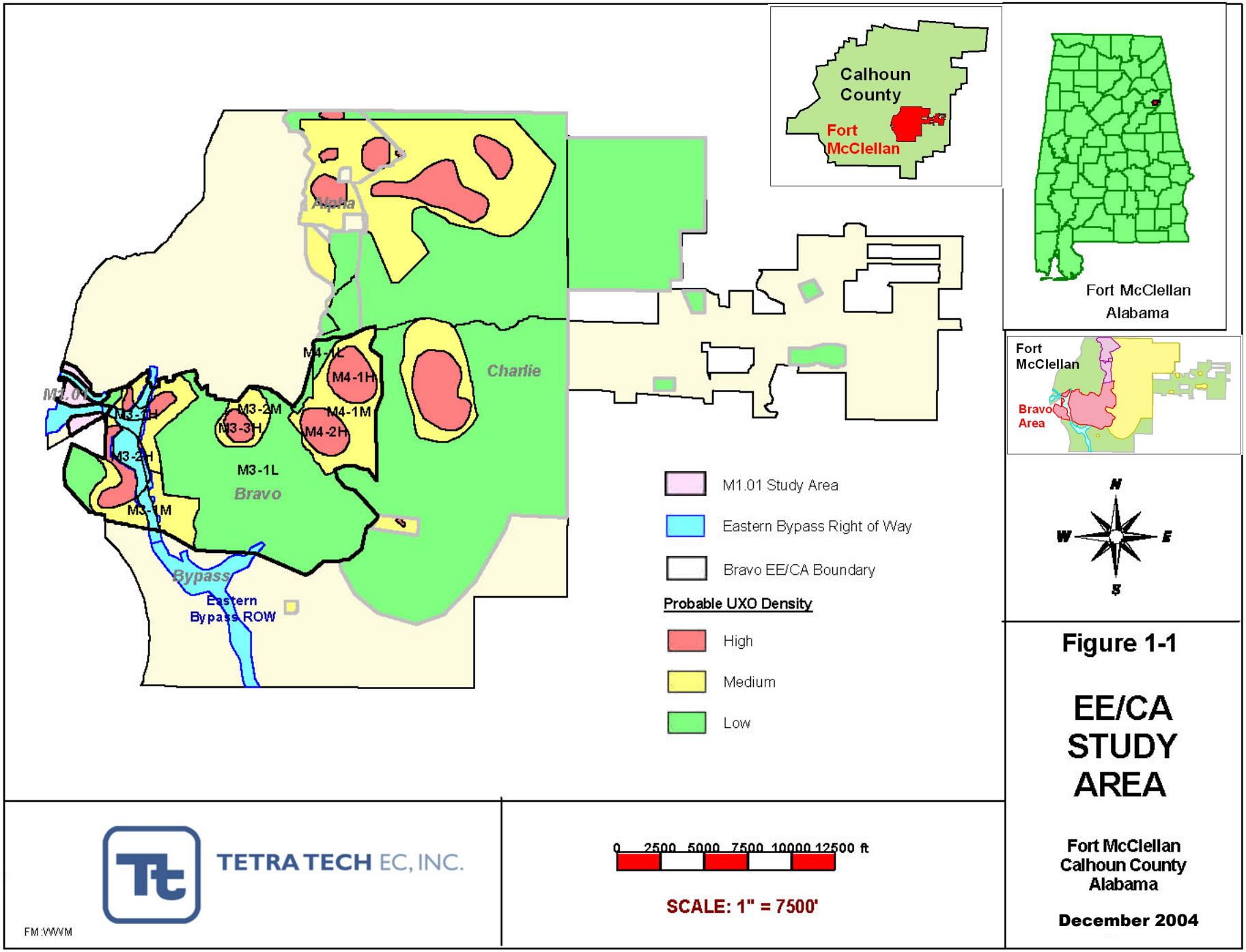


Figure 1-1

EE/CA STUDY AREA

Fort McClellan
Calhoun County
Alabama

December 2004

THIS PAGE INTENTIONALLY LEFT BLANK.

2.0 SITE DESCRIPTION AND HISTORY

2.1 SITE LOCATION

Fort McClellan is located northeast of the City of Anniston, Calhoun County, Alabama. To the west of the Fort are the areas known as Weaver and Blue Mountain; to the north is the City of Jacksonville. The Talladega Forest is located east of the Fort. Fort McClellan occupies 18,929 acres adjacent to the city of Anniston, Alabama. The portion of Fort McClellan to be addressed in this EE/CA has been designated the Bravo Area, and lies in the south central portion of the base, immediately south and east of the main cantonment area. The Bravo Area comprises a large portion of the Redevelopment Area. It extends from the western boundary of Fort McClellan near Alabama Highway 21, eastward along the southern edge of the Main Cantonment area, into the central portion of Fort McClellan. The entire Bravo area lies west of the highest ridges of the Choccolocco Mountains. The area is south and west of the Alpha Area, which comprises the remainder of the Redevelopment Area. The Choccolocco Mountains and the Choccolocco Corridor, which comprise the Charlie Area, are east of the Redevelopment Area. The Alpha portion of the Redevelopment Area has been addressed in a previously submitted EE/CA. The Charlie Area will be addressed in a subsequent EE/CA. Figure 1-1, located at the end of Chapter 1.0, shows the location of the Bravo Area within Fort McClellan. Figure B-1, Bravo Area Ranges and Impact Areas, located in Appendix B, shows the location of historical ranges in Bravo.

2.2 PHYSICAL DESCRIPTION

The Bravo Area consists of approximately 3,325 acres. The area is heavily to moderately wooded with mixed pines and hardwoods; but does have some open areas that were cleared for various activities during the active operation of the installation. Numerous paved and unpaved secondary roads are present, along with occasional structures, most of which are no longer in use. There are no active facilities located within the Bravo Area, however, the western portion is bisected by a major active highway project known as the Eastern Bypass.

2.2.0.1 For the purposes of this EE/CA, the Bravo Area was divided into ten Characterization Sectors based on the likelihood of OE being present as developed in the Bravo Area EE/CA Work Plan. These were designated as Sectors M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, M3-3H, M4-1L, M4-1M, M4-1H, and M4-2H. The first part of the sector name was based on the parcel name used by the Army; while the second part designated the expected OE density within the area. The Army and the JPA had divided Fort McClellan into parcels of property, designated by the letter "M" and a number, to facilitate discussions of land transfer. These parcels were not developed for use in determination of where response actions would occur. The Bravo Area includes Parcels M3 and M4. The ten Characterization Sectors that comprise the Bravo Area are depicted on Figure 2-1.

2.2.1 Geology

Fort McClellan is situated near the southern terminus of the Appalachian Mountain chain. All but the easternmost portion of the Main Post lie within the Valley and Ridge Province of the Appalachian Highlands. The portion of Fort McClellan east of Choccolocco Creek lies within the Piedmont Province. The age of the consolidated sedimentary and metamorphic rocks range from Precambrian to Pennsylvanian. On a large scale, most of the rocks have been intensely folded into an aggregate of northeast-southwest trending anticlines and synclines with associated

thrust faults. The shallow geology in the area is characterized by colluvial deposits. Table 2-1 summarizes the major stratigraphic units underlying Fort McClellan. The presence of metamorphic rocks, as well as iron-bearing cements within the sedimentary rocks, increases the potential for minerals such as magnetite and other associated magnetic minerals. If magnetic minerals were identified they were noted during the surveying and/or data interpretation activities. Figure 2-2, located at the end of this chapter, presents the geology in the Bravo Area.

Table 2-1
Summary of Major Stratigraphic Units

Period	Formation	Thickness (feet)	Lithology
Quaternary	Alluvium, colluvium, and undifferentiated deposits	--	Alluvium, sandy to clayey; slope wash, gravel, and sand.
Tertiary	Deposits of Paleocene or early Eocene age	10-100	Clay, sand, and gravel.
Pennsylvanian	Pottsville Formation	300?	Sandstone, gray and brown with interbedded gray and brown shale.
Mississippian	Parkwood Formation	350	Sandstone, gray, feldspathic, silica - cemented, fossiliferous; and gray clayey shale.
	Floyd Shale	2,000	Shale, black to greenish-black, fissile; interbedded with minor thick to thin, greenish-gray sandstone and clayey limestone beds.
	Fort Payne Chert	100-350	Chert, finely broken; includes some dark flint in basal part; highly fossiliferous.
	Maury Formation	2-3	Claystone, green, locally red, and phosphate nodules; locally interbedded with red shale.
Devonian	Frog Mountain Sandstone	50	Sandstone, brown, coarse-grained, siliceous cement; locally includes dark, hard, siliceous shale or gray very coarse-grained, thick-bedded with light-brown shale.
Silurian	Red Mountain Formation	50	Sandstone, light-gray to white, thick-bedded to massive, 30 feet thick; overlain by 20 feet of light- brown, thin-bedded sandstone interbedded with light- brown shale.
Ordovian	Sequatchie Formation	100	Siltstone and shale, calcareous, maroon and greenish-gray mottled, locally fossiliferous.
	Chickamauga Limestone	275-325	Sandstone, white to light-gray, thick- to thin-bedded orthoquartizitic; well-sorted medium to coarse, rounded to well-rounded grains; locally conglomeratic; bentonitic beds in upper part of formation; maroon and orange-brown variegated shale and siltstone, with irregular lenses of thinly laminated, gray to gray-green and maroon sandstone; limestone and calcarious mudstone in lower part; locally fossiliferous.
	Little Oak Limestone	15	Limestone, gray crystalline, medium- to thick- bedded, fossiliferous; black, fissile shale interbedded with dark shaley limestone.
	Athens Shale	200	Limestone, gray, crystalline, medium- to thick-bedded, fossiliferous; black, fissile shale interbedded with dark shaley limestone.
	Lenoir Limestone	15	Limestone, gray, crystalline, medium- to thick-bedded, fossiliferous; black fissile shale interbedded with dark shaley limestone.
	Newala Limestone and Longview Limestone Undifferentiated	400-600	Limestone, pearl-gray, dark-gray, and bluish-gray, dense, medium- to thick-bedded; thin beds of coarse-grained dolomite; fine-grained chert common in the Longview.

Table 2-1: Summary of Major Stratigraphic Units
(continued)

Period	Formation	Thickness (feet)	Lithology
Ordovician and Cambrian	Chepultepec Dolomite, Copper Ridge Dolomite, and Ketona Dolomite, undifferentiated	2,000	Dolomite, siliceous; abundant chert except in the Ketona.
Cambrian	Conasauga Formation	500	Limestone, dolomitic limestone, and crystalline gray dolomite; thin beds of gray shale that weathers green. Shale is dominant facies to the north and northwest.
	Rome Formation	1,000	Shale and siltstone, red; green shale and red and light-gray sandstone; locally includes lenticular beds of light-gray limestone or dolomite.
	Shady Dolomite	1,000	Limestone and dolomite, yellowish to light- to dark-gray, crystalline, medium- to thick-bedded; variegated clayey shales in lower part.
	Weisner Formation	2,500	Shale, siltstone, sandstone, quartzite, and Conglomerate; forms mountains. Local deposits of bauxite, hematite, and limonite.

2.2.2 Hydrogeology

Few hydrogeological assessments of regional groundwater flow patterns have been conducted in the area surrounding Fort McClellan. Aquifers in the area are developed in residual soil derived from weathering of bedrock, within fractured bedrock, along fault lines and within karstic units. Groundwater flow is generally toward major surface-water features. However, because of differential weathering, variable fracturing and the potential for conduit flow, topography as an indicator of groundwater flow direction must be used with caution. Groundwater intersecting the ground surface has resulted in numerous springs, which act as important sources of discharge and water supply in the area (SAIC, 1999). Precipitation is the primary source of recharge to groundwater in Calhoun County and thrust fault-zones form conduits for groundwater movement. Points of discharge are springs, effluent streams and lakes. Shallow groundwater on Fort McClellan occurs principally in the residuum developed from Cambrian sedimentary bedrock units of the Weisner Formation, part of the Chilhowee Group and locally in Ordovician carbonates. Bedrock permeability may be locally enhanced by fracture zones associated with thrust faults and by solution of limestones. Surface-water movement into sinkholes provides another source of groundwater recharge and locally has facilitated the formation of caves (SAIC, 1999).

2.2.3 Topography

The topographic gradient at Fort McClellan generally increases towards the south and east of the main installation, with local relief in excess of 1,320 feet. The lower elevations [700 feet above mean sea level (msl)] occur along Cane Creek, near Baltzell Gate Road, while the maximum elevations (2,063 feet above msl) occur on Choccolocco Mountain, which traverses the area in a north/south direction, with the steep easterly slopes grading abruptly into Choccolocco Valley. The western slopes are more continuous with the southern extension maintaining elevations up to

900 feet above msl near the western reservation boundary. The northern extension decreases in elevation in the vicinity of Reilly Airfield. The central portion of Fort McClellan is characterized by flat to gently sloping land. Topography within the Bravo Area consists of moderately sloped rolling hills to very steep mountain slopes, with intervening moderately to deeply incised valleys. Elevations range from approximately 800 feet above msl in places along the northern edge of Bravo to over 1,700 feet above msl at the highest point along the southern edge of the area. Surface drainage is predominantly to the north by way of Remount Creek and the South Branch of Cane Creek, and their tributaries.

2.2.3.1 The M4 Sectors

The M4 Sectors (M4-1L, M4-1M, M4-1H, and M4-2H) comprise an area that is generally rectangular in shape and trends north-south (see Figure 2-1). It is approximately 1.75 miles in length and 1 mile in width. The cluster of sectors are bounded to the north by Bains Gap Road, to the east by a string of hills at the foot of the Choccolocco Mountains, to the south by Kellog Drive, and to the west by Rocky Hollow Road. The topographic gradient within the M4 Area gently increases to the southeast and abruptly changes into a string of steep hills, which include Holloway Hill. There is also a significant unnamed hill located in the northeast corner of the area, directly adjacent to Bains Gap Road. Ingram Creek and South Branch Creek also flow through this area.

2.2.3.2 The M3 Sectors

The M3 Sectors (M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, and M3-3H) define an area that is approximately square (see Figure 2-1). The area is approximately 3.5 miles in length and 2.25 miles in width. To the north the sectors are bounded by the building and office facilities that define the main administrative center of the Base, to the east by Kellog Drive, and to the west by the property boundary of the Base. The M3 Sector is extremely rugged terrain including the following hills: Iron Mountain, Wheeler, Reynolds, Perry, Gardner, Ford, Jerry, Baltzell, Sunset, and Howitzer. The entire area is defined by undulating terrain alternating between topographic highs and lows. The area also includes Yahoo Lake and several creeks and streams.

2.3 SITE HISTORY

Fort McClellan has documented use as a military training area since 1912, when the Alabama National Guard used it for artillery training. However, the Choccolocco Mountains may have been used for artillery training by the units stationed at Camp Shipp in the Blue Mountain Area during the Spanish American War as early as 1898. The 29th Infantry Division used areas of Fort McClellan for training prior to being ordered to France during World War I (WWI). In 1917, Congress authorized the establishment of Camp McClellan and in 1929, the camp was officially designated as Fort McClellan. Prior to World War II (WWII), the 27th Infantry Division assembled at Fort McClellan for training and many other units used the site for various training purposes during the war. Following WWII, in June 1947, the Fort was inactivated. It was reactivated in January 1950 and the site was used for National Guard training and was also selected as the site for the Army's Chemical Corps School.

2.3.1 Fort McClellan was recommended for closure under the BRAC Program, and was closed in September 1999. At this time, local, State, and Federal interests are deciding the future

use of Fort McClellan. A Transition Team is now in place to facilitate disposition of Fort McClellan properties to private ownership and/or transfer to other government entities.

2.3.2 The history of Fort McClellan, as described in the Archives Search Report (ASR) Findings (USACE, 1999a) and Archives Search Report Conclusions and Recommendations (USACE, 1999b) includes training activities and demonstrations that used conventional weapons (i.e., mortars, anti-tank guns and artillery). Chemical warfare training occurred during several periods of time that included the use of such items as chemical agent identification sets (CAIS), smoke pots, flame field expedients (FFE), rifle and smoke grenades. A review of the ASR Conclusions and Recommendations indicates that the majority of the chemical inventory was transferred from Fort McClellan in 1976. In 1987, the Chemical Decontamination Training Facility located northeast of Bravo in the Alpha Area of Fort McClellan became operational. Specific training areas and ranges within the Bravo Area, along with associated ordnance items historically used in the Bravo Area, are presented in the Conceptual Site Model (CSM) for each of the EE/CA Characterization Sectors (see Chapter 4.0). A summary of historical activities in the area can be found in the ASR for Fort McClellan, and in the Reconnaissance Findings, Conceptual Plan, and Proposed Scope of Work for EE/CA Sampling document prepared by TtEC in August 2000 (USACE, 1999a) (Foster Wheeler Environmental, 2000).

2.4 DEMOGRAPHIC PROFILE

Fort McClellan is located in Calhoun County at the foothills of the Appalachian Mountains. The surrounding communities, including Weaver, Pelham Range and Anniston (the county seat), offer multiple centers of activity such as Oxford Lake and Civic Center, Cheaha State Park, Jacksonville State University, Anniston Museum of Natural History, Northeast Alabama Regional Medical Center and several theaters, park facilities and golf courses.

2.4.1 According to the 2000 Census of Population and Housing, Calhoun County is home to approximately 112,249 people within a 608 square-mile area, averaging 184.6 people per square mile. The percentage of individuals under age 19 is 26.8 percent; the percentage over age 65 is 14.2 percent. The median age is 37.2. Approximately 79.7 percent of the population is white, 18.8 percent African American, 0.8 percent American Indian or Alaska Native, 0.8 percent Asian, 0.1 percent Native Hawaiian or Pacific Islander, and 0.8 percent other races.

2.4.2 Housing in Calhoun County is composed of 51,322 multiple and single family dwellings. Approximately 72.5 percent of the households are owner occupied, and 27.5 percent of the households are rental units.

2.4.3 The total population for the City of Anniston is 24,276. The percentage of individuals under the age of 19 is 26.3 percent and over the age of 65 is 18.7 percent. The median age is 39.3. Approximately 46.7 percent of the population is white, 48.7 percent is African American, 0.3 percent is American Indian and Alaska Native, 0.8 percent is Asian, and 0.7 percent other races. The City of Anniston has approximately 10,447 occupied housing units, of which 59.5 percent are owner occupied and 40.5 percent are rented.

2.4.4 Calhoun County's medical facilities and court system serve as the legal, medical, and accounting center of that region of Alabama. Retail, entertainment and recreational establishments also thrive in this area.

2.4.5 A variety of industries including Federal and civilian government, services, durable goods manufacturing, and the area's agricultural industry are strong contributors to the local economy. Honda (automotive facility), Mead Ink, Hager Hinge (hinges), Parker Hannifin (valves), Bear (knives), Springs Industries (comforters), Allied Signal (aircraft systems), North American Bus Industries (transit buses), Bostrom Seating (truck seating), and Legacy Cabinets (kitchen cabinets) are just a few of the more than 150 industries located in or near Calhoun County.

2.5 CURRENT AND FUTURE SITE USE

Currently, the Bravo Area is abandoned and not in use by any agency or group. Future use of the area is anticipated as Retail, Mixed Business Use, Cultural, Active Recreation, Passive Recreation, and for Development Reserve. There is also a potential that one area of Bravo may be used as residential.

2.6 PREVIOUS INVESTIGATIONS

A number of previous investigations have been conducted that provide useful information regarding the potential presence of OE at Fort McClellan. Several studies specifically addressed OE at Fort McClellan, including the Bravo Area, while others were aimed at OE and other environmental issues on a site-wide basis. The discussion below includes those previous investigations that included information specifically pertinent to potential OE contamination within the Bravo Area. All previous investigation and decision documents related to OE investigations/removals on Fort McClellan can be found at the Anniston-Calhoun Public Library or the Houston Cole Library at the Jacksonville State University. TtEC utilized these documents during the records search phase of the project that preceded the current EE/CA investigation phase.

2.6.1 Archives Search Report (ASR), US Army Corps of Engineers (USACE, 1999a) - An ASR was prepared by the US Army Corps of Engineers, St. Louis District in 1997, and revised in 2000 and 2001 based on additional information. This document was used as the basis for much of the EE/CA reconnaissance work performed by TtEC at the site. The ASR was prepared by reviewing available records and reports documenting the history of the site. Historical information pertaining to site operations, including a listing of site investigations conducted before 1996, is contained within the ASR. The ASR describes known historical OE-related activities at Fort McClellan. The document includes maps with the locations of known range safety fans, as well as ordnance firing points, types of ordnance reportedly used at the various ranges, and dates of operation of ranges, firing fans, and training areas. The Army has revised the ASR to include more complete information concerning training areas on the installation.

2.6.2 Environmental Baseline Survey (EBS), Environmental Science and Engineering, Inc. (ESE) (ESE, 1998) - The EBS for Fort McClellan was completed by ESE in January 1998. Through the use of records reviews, interviews, and site inspections, the report documented the status of Hazardous, Toxic, and Radiological Wastes (HTRW) and OE issues at Fort McClellan and Pelham Range. The report provides a summary of known OE sites at Fort McClellan, and was useful in confirming and/or supplementing the information contained in the ASR.

2.6.3 Historical Aerial Photograph Investigation, Oak Ridge National Laboratories (ORNL) - This investigation was completed in August 1999 by ORNL for USAESCH. The purpose of the study was to conduct digital photographic interpretation of historical photographs and anomaly resolution and tracking of ten sites within Fort McClellan. A portion of the Bravo Area was covered by this study and falls within the area designated by ORNL as Range Sites 4, 5, 6, 7, 8, and 10. The study included an analysis of photographs dating from 1937 to 1994, and a number of anomalies were identified that are associated with known ranges in the area. Photographic anomalies were classified as unidentified objects, unidentified structures, ammunition ranges, a skeet and trap range, training areas, bivouac sites, areas of trails and clearings, a trail with no outlet, areas cleared of scrub and ground cover, and a road in a cleared area. No photographs dated later than 1994 were reviewed (ORNL, 1999).

2.6.4 Environmental Photographic Interpretation Center (EPIC) aerial photograph investigation, EPA - This study, which included examination of historical photographs, was conducted by the EPA in 1990 to help determine the history and locations of potential environmental issues at Fort McClellan. Numerous photographic anomalies were identified. The study was useful as a separate source for locating potential OE related sites within the EE/CA study area, and supplemented the other documents containing historical information and photographs (EPA, 1990).

2.6.5 Reconnaissance Findings, Conceptual Plan, and Proposed Scope of Work, Foster Wheeler Environmental Corporation- This report was submitted in August 2000 following the site reconnaissance phase of the EE/CA process at Fort McClellan. The report includes a tabular summary of historical ordnance use at the various ranges, a description of the site reconnaissance activities performed in the field, a summary of the ordnance related and non-ordnance related findings, and a map showing proposed OE Characterization Sectors to be used in the EE/CA sampling. A detailed description of the proposed scope of work was presented, along with the rationale used to define Characterization Sectors and the proposed sampling acreage for each sector. Non-ordnance related data such as terrain type and vegetation cover were also collected during the reconnaissance to help in planning the OE sampling. This document is included as Appendix C to the approved Site-Specific Work Plan for the Bravo Area (Foster Wheeler Environmental, 2000).

2.6.6 Parsons conducted a RCWM EE/CA for Fort McClellan, including a site designated as the Old Burn Pit (Parsons, 2002). This site is located within the northern portion of Sector M3-1L of the Bravo EE/CA. The field sampling activities for the Old Burn Pit included three excavations. The sampling was geared toward RCWM characterization of these areas, but the results provide data that can be used in the characterization of conventional ordnance as well. The Parsons data was incorporated into the Bravo EE/CA as it pertained to conventional OE contamination issues. Findings included only OE Scrap and Non-OE Scrap. OE Scrap excavated in the three Old Burn Pit excavations included a practice grenade (MK2), practice rifle grenade bodies, practice 60mm mortars, an 81mm mortar (empty, unfuzed, no primer), practice rifle grenade tail booms, and small arms components.

2.7 ANALYSIS OF HISTORICAL RECORDS

TtEC reviewed existing documents to gather information on historical range fan locations; firing points and impact areas within the fans; and types of ordnance reportedly used at Fort McClellan. The 1999 ASR was the primary source of historical information; but other reviewed documents included the1999 Historical Aerial Photograph Investigation, the 1997 EBS, and the 1990 EPIC aerial photograph investigation.

2.7.0.1 To organize the historical information, TtEC designated sectors within the Bravo Area with a two part naming system. The first part of the sector name was based on the parcel name used by the Army (e.g., M3 and M4); while the second part designated the likelihood of OE presence within the area (e.g., L for low). The Army and JPA had divided Fort McClellan into parcels of property, designated by the letter "M" and a number, to facilitate discussions of land transfer. These parcels were not developed for use in determination of where response actions would occur. The Bravo Area includes Parcels M3 and M4. For discussing the conclusions and recommendations, the ASR divided Fort McClellan into four major geographic areas: the Washington Range Area, the Bandholtz Range Area, the Defendum Range Area, and the Choccolocco Corridor. These four divisions cover large areas of Fort McClellan. Only training areas located within the Washington Range and Bandholtz Range Areas are located within the Bravo boundaries. Therefore, these relevant training areas are discussed in the following paragraphs.

2.7.1 The M4 Sectors

The M4 Sectors (M4-1L, M4-1M, M4-1H, and M4-2H) (see Figure 2-1) are located within the Bandholtz Range Area, which is located to the south of Bains Gap Road and east of Rocky Hollow Road (see Figure 2-1). Previous investigations conducted in and around this section of the Bandholtz Range Area indicate the presence of historical impact areas. The following includes the names and known histories of specific firing ranges, training areas, and bivouac areas located within the M4 Sectors and comprise the Bandholtz Range Area. It should be noted that the ordnance associated with these ranges are not necessarily HE rounds since they were used for training purposes. Items found during reconnaissance activities were not handled, excavated, or removed, so determination was not made as to whether they were high explosive, practice, or training rounds.

- The Bandholtz Rifle Range (later renamed Range 25) was built during the Inter-War period. It was in continuous use as a known distance range since its original establishment up to the time of base closure. Parts of this range may be included in the impact area of the WWI Artillery Range (OA-37).
- Range 22, built during the Vietnam War period, was in continuous use as a rifle range until base closure. The range is located within the impact area of the WWI Artillery Impact Area (OA-33).
- Range 23 started in the Inter-War period as a pistol range and was then subsequently used as a rifle and machine gun range. It is located within the impact area of the WWI Artillery Impact Area and part of the range is included in Combat Range #1 used during the Inter-War period. An expended 81-millimeter (mm) mortar round was identified at the surface during a site visit on the south side of Range 23 (OA-41).

- Old Range 21 was built after WWII for use as a rifle range and was abandoned in 1967. This range is located within the impact area of the WWI Artillery Impact Area and part of the range is also included within Combat Range #1 used during the Inter-War period (OA-42).
- Old Range 27, built after WWII, is shown with a safety fan similar to those associated with rifle and machine gun live fire. The range, which was abandoned by 1967, is located within the impact area of the WWI Artillery Impact Area (OA-35).
- Combat Range #1 was built during the Inter-War period and was used for 37mm anti-tank guns and 75mm artillery guns. There is historical evidence that a portion of the land that is now part of the range was also used for artillery and mortar firing during WWI (OA-43).
- Range 20, the Infiltration Course, was active from the mid 1980s until base closure. Demolition devices and M60 machine guns were used on this course (OA-70).
- Range 26 had two purposes during its existence: an Infiltration Course and a Live Fire and Maneuver Range. Historically, the weapons used on this range included military small arms firing, .30 caliber and 5.56mm rounds. During a site visit, a signal illumination parachute flare was identified at the surface.
- The Blank Fire and Maneuver Range, also known as Range 28, was an active range from 1976 until base closure. The facilities present during its use include bleachers, latrines, a target house, a tower, and five firing lanes. Historical data suggests the M-16 (blanks) was the only weapon used on this range. The range is located within the WWI Artillery Impact Area. During fieldwork, multiple 3 inch projectiles, multiple 3 inch stokes mortars, multiple M18 smoke grenades, and fighting positions were identified in this area (OA-72).
- Weapons Demo (ITT) Range, also known as Range 29, was active from 1976 until base closure. Historically the weapons used on this range were .38/.45 caliber pistols, 5.56mm rifle (M16), 7.62 machine gun (M60), light anti-tank weapon (LAW) (M72), and 40mm grenade launchers (M203s) (OA-73).
- Hand Grenade Range, also known as Range 32, was active from 1987 until base closure. Hand grenades were used on this range (OA-74).
- Bivouac Site B-23 potentially contains training debris such as expended rifle blanks and pyrotechnic devices (i.e., smoke grenades) (OA-38).

2.7.1.1 Ordnance and Explosives historically associated with the M4 Sectors are listed in Table 2-2.

Table 2-2
Ordnance and Explosives Historically Associated with the Bravo Area

Characterization sector	Historical Area	Ordnance and Explosives Associated with the Historical Area
M3-1H	Rocket Range	Rockets, 2.36-inch, 3-inch and 5-inch
	Machine Gun Range	Small Arms (Various Caliber)
	2 Rifle Grenade Ranges	Grenade, Rifle (M9)
	Combat Range #2 (a.k.a. Rocket Range; Machine Gun Range; 2 Rifle Grenade Ranges)	Rockets; Small Arms; Rifle Grenades
	Skeet Range	Various Gauge Shotguns
M3-1L	2 Rifle Grenade Ranges	Grenade, Rifle
	Hand Grenade Range	Hand Grenades
	Range 16 (originally, later Rocket Launcher/Bazooka Range and Range 17 (Rifle Grenade))	Grenade Court; Small Arms; 40mm Grenades (launched); Rockets
	60mm Mortar Range	Mortar, 60mm HE
	Washington Tank Range (Tank Table 1-2-3)	Small Arms; 37mm Sub Caliber Rounds
	Old Range 12 (Range 12; Rifle Field Firing)	Small Arms
	WWI Machine Gun Camp	Small Arms
	1950 Rocket Launcher Range	Rockets, 2.36-inch
	Washington Rifle Range (Range 18)	Small Arms
	Range 15 (a.k.a. Combat Village)	Small Arms; Light Anti-Tank Weapon
	Range 12 (a.k.a. Range 14)	Small Arms; Light Anti-Tank Weapon; Anti-Tank; 60mm Projectiles; Rockets
	Range 13	Small Arms; Light Anti-Tank Weapon
	Range 19	Small Arms
	Machine Gun Range	Small Arms
	World War I Artillery Range (North Area)	Artillery; Mortars
	World War I Artillery Range (South Area)	Artillery; Mortars
M3-1M	Machine Gun Range	Small Arms
	Range 15 (a.k.a. Combat Village)	Small Arms; Light Anti-Tank Weapon
	Range 12 (a.k.a. Range 14)	Small Arms (Various Caliber); Light Anti-Tank Weapon; 60mm Projectiles; Rockets
	Range 13	Small Arms; Light Anti-Tank Weapon
	Range 19	Small Arms
	Old Range 12 (Range 12, Rifle Field Firing)	Small Arms
	Rifle Grenade Ranges (2)	Grenade, Rifle (M9)
	Combat Range #2 (Rocket Range; Machine Gun Range; 2 Rifle Grenade Ranges)	Rockets; Small Arms; Rifle Grenades

Table 2-2
Ordnance and Explosives Historically Associated with the Bravo Area
(Continued)

Characterization sector	Historical Area	Ordnance and Explosives Associated with the Historical Area
M3-1M	60mm Mortar Range	Mortar, 60mm HE
	Washington Tank Range (Tank Table 1-2-3)	Small Arms; 37mm Sub Caliber Rounds
	Rocket Range	Rockets, 2.36-inch; 3.5-in
	Skeet Range	Various Gauged Shotguns
	1950 Rocket Launcher Range	Rockets, 2.36-inch
M3-2H	Multiple Small Arms Ranges	Small Arms
	Old Range 12 (Range 12; Rifle Field Firing)	Small Arms
	1950 Rocket Launcher Range	Rockets, 2.36-inch
	60mm Mortar Range	Mortar, 60mm HE
	Washington Tank Range (Tank Table 1-2-3)	Small Arms, 37mm Sub Caliber
M3-2M	Washington Rifle Range (a.k.a. Range 18)	Small Arms
	Old Range 12 (Range 12; Rifle Field Firing)	Small Arms
	Range 13	Small Arms; Light Anti-Tank Weapon
	Range 19	Small Arms
	Range 16 (originally, later Rocket Launcher/Bazooka Range and Range 17 (Rifle Grenade Range))	Small Arms; Rockets; Grenade, Rifle 40mm
M3-3H	Range 16 (originally, later Rocket Launcher/Bazooka Range and Range 17 (Rifle Grenade Range))	Small Arms; 40mm Grenades; Grenade Court; Rockets
	Old Range 12 (Range 12; Rifle Field Firing)	Small Arms
	Range 19	Small Arms
	Range 13	Small Arms; Light Anti-Tank Weapon
M4-1H	World War I Artillery Range (North Half)	Artillery; Mortars
	Bandholtz Rifle Range (a.k.a. Range 25)	Small Arms
	Range 23 (a.k.a. Pistol Range; Rifle/Machine Gun Range)	Small Arms; 81mm Mortar Rounds
	Infiltration Course, Range 20	M60 Machine Guns; Demolitions
	Blank Fire and Maneuver Range (a.k.a. Range 28)	81mm and 60mm Mortar Rounds; 3-inch Stokes Mortars; M18 Smoke Grenades; Livens Projectiles
	Infiltration Course (a.k.a. R-26; Range 20)	Not Indicated
M4-1L	World War I Artillery Range (North Half)	Artillery; Mortars
	World War I Artillery Range (South Half)	Artillery; Mortars
	Battalion Size Bivouac Area (B-25)	Training Debris (Rifle Blanks); Pyrotechnic Devices (Smoke Grenades)
	Bandholtz Rifle Range (a.k.a. Range 25)	Small Arms
	Bivouac Site 42	Not Indicated

1

Table 2-2
Ordnance and Explosives Historically Associated with the Bravo Area
(Continued)

Characterization sector	Historical Area	Ordnance and Explosives Associated with the Historical Area
M4-1M	World War I Artillery Range (North Half)	Artillery; Mortars
	World War I Artillery Range (South Half)	Artillery; Mortars
	Combat Range #1	37mm Anti-Tank; 75mm Artillery Guns; 81mm Mortar Rounds
	Infiltration Course, Range 20	M60 Machine Guns; Demolitions
	Range 23 (a.k.a. Pistol Range; Rifle/Machine Gun Range)	Small Arms; 81mm Mortar
	Bandholtz Rifle Range	Small Arms
	Old Range 21	Small Arms
	Range 12 (a.k.a. Range 14)	Small Arms; Light Anti-Tank Weapon; 60mm Mortars; Rockets
	Range 13	Small Arms; Light Anti-Tank Weapon
	Range 19	Small Arms
	Bivouac Site B-23	Training Debris (Rifle Blanks); Pyrotechnic Devices (Smoke Grenades)
	Infiltration Course (a.k.a. Range 26)	Small Arms; Pop-Up Flares
	Blank Fire and Maneuver Range (a.k.a. Range 28)	M16A1; 81mm and 60mm Mortar Rounds; 3-inch Stokes Mortars; M18 Smoke Grenades; Livens Projectiles
	Weapons Demo (a.k.a. ITT Range; Range 29)	Small Arms; Light Anti-Tank Weapon; 40mm Grenades; AT-4; M203; 75mm Projectile Fragments and Shrapnel
	Bivouac Site 43	Pop-Up Flares
M4-2H	World War I Artillery Range (South)	Artillery; Mortars
	Old Range 21	Small Arms
	Range 12 (a.k.a. Range 14)	Small Arms; Light Anti-Tank Weapon; 60mm Mortars; Rockets
	Range 13	Small Arms; Light Anti-Tank Weapon
	Range 19	Small Arms
	Range 23 (a.k.a. Pistol Range; Rifle/Machine Gun Range)	Small Arms; 81mm Mortar Rounds
	Old Range 12 (Range 12; Rifle Field Firing)	Small Arms
	Weapons Demo (a.k.a. ITT Range; Range 29)	Small Arms; Light Anti-Tank Weapon; 40mm Grenades; At-4; 75mm Fragments and Shrapnel
	Combat Range #1	37mm Anti-Tank; 75mm Artillery Guns; 81mm Mortar Rounds

Source: Archives Search Report (USACE, 1999), and Bravo EE/CA Conceptual Site Models.

2

2.7.2 The M3 Sectors

The M3 Sectors within the Bravo Area are: M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, and M3-3H (see Figure 2-1). These sectors are part of the Washington Range Area, which is located to the west of Rocky Hollow Road and south of Summerall Gate Road. The Washington Range Area is a grouping of several ranges from the ASR. It includes OA-01, OA-2, OA-45, and OA-47 though 57. These are shown on the Bravo Area Ranges and Impact Areas Map, Figure B-1, located in Appendix B. Previous investigations conducted in and around this section of the Washington Range Area indicated the presence of historical impact areas. The following includes the names and known histories of specific firing ranges, training areas, and bivouac areas that are located within the M3 Sectors.

- Washington Rifle Range Area was in continuous use as a rifle range and there is no indication of explosive ordnance being used on this range.
- Range 16 was established during WWII as a grenade court. In 1958 the range was divided into a Rocket Launcher (Bazooka) area (Range 16) and a Rifle Grenade area (Range 17). In 1967 the two ranges were again consolidated and used for rocket launchers and 40mm grenade launchers (OA-45).
- The Rocket Range was used during WWII and was part of Combat Range #2 until 1958 when it was abandoned. During a site visit, 2.36" rockets (bazookas) were identified at the surface. Three point five inch rockets may have also been used on this range (OA-1).
- The Machine Gun Range was used during WWII and is part of Combat Range #2 (OA-2).
- The Rifle Grenade Ranges are two rifle grenade ranges that were used during WWII. Both of the ranges were abandoned by 1958. During a site visit, remnants of WWII vintage rifle grenades were found northeast of Range 19, on the south side of an old service road (OA-51).
- Combat Range #2 was built during the Inter-War period. There is no documentation of its initial use, but during the war it was divided into several ranges including a rocket range, a machine gun range, and two rifle grenade ranges, all of which were abandoned by 1958 (OA-52).
- A 60mm Mortar Range was established during WWII and abandoned sometime between 1958 and 1967. During a site visit, remnants of 60mm HE mortar rounds were identified at the surface (OA-53).
- The Washington Rifle Range was instituted in 1958 and abandoned by 1967. Use of this range is unknown, but its use may have been associated with the reserve units located on Highway 21 (OA-54).
- Old Range 12 was built during WWII as a landscape range and was abandoned by 1967. By 1958, the range was referred to as Range 12, Rifle Field Firing (OA-55).
- Range 12 was built after WWII and was used as a competitive pistol range, 1967 (OA-48).
- Range 13, the Washington Pistol Qualification Range, was established during the Vietnam War and was active until base closure (OA-49).
- Range 15 was built after WWII and has a safety fan similar to ones used for rifle and machine gun live fire. The range was abandoned in 1967 (OA-47).

- Range 19 was built during the Vietnam War as a 10 meter Machine Gun Range. Later it was developed into a Pistol Qualification Range (OA-50).
- The Machine Gun Camp was operated during WWI. The exact location of the machine gun range within the camp is unknown (OA-56).
- The 1950 Rocket Launcher Range appears on a 1950 range map. The range map shows a 2.36" Rocket Launcher Range north of the 60mm mortar range. The range was abandoned sometime before 1958 (OA-57).

2.7.2.1 Ordnance and Explosives historically associated with these areas are also listed in Table 2-2.

2.8 PREVIOUS REMOVAL ACTIONS

Records do not indicate any previous removal actions that commenced before this EE/CA process began in the Bravo Area.

2.9 INTERIM REMOVAL ACTIONS

2.9.1 Eastern Bypass (EBP) "Y" Area Junction

The "Y" Area Junction of the Eastern Bypass (EBP) is located within the Bravo Area. The "Y" Area is approximately 60 acres and includes the following Bravo Area sectors: M3-1H Grenade Area-D, a portion of M3-1H Grenade Area-PR, and M3-1H Rocket Area-D. These sectors are indicated in the upper left portion of Figure 2-2 and the "Y" Area is shown in Figure 2-3.

2.9.1.1 An Interim Removal Action was performed in the "Y" Area Junction of the EBP to prevent conflicts with an Alabama Department of Transportation (ALDOT) construction project. ALDOT planned to start construction of the Summerall Gate Road in close proximity to this area. The work was completed in sequential steps of site preparation: brush clearing, geophysical survey, and intrusive operations between April and November 2003. A Clearance to Depth was completed in all of these areas, even though Clearance to One Foot was recommended in M3-1H Grenade Area-PR. Intrusive investigation of anomalies resulted in the excavation of 60 UXO items, 2,460 pounds of OE Scrap, and 8,430 pounds of Non-OE Scrap. The removal action was documented in the January 2004 *Site Specific Final Report for the Eastern Bypass "Y" Area Junction.* The report is in Draft Final form and there is currently no statement of clearance.

2.9.2 Dog Kennel Area

The Dog Kennel Area, situated on approximately 2 acres within the Bravo Area, was used by the Army to kennel dogs. The area lies mostly in Bravo risk sector M3-1H Grenade Area-PR which is recommended in this EE/CA for a one-foot clearance, but a small portion of the kennel area is in M3-1L 37mm Projectile Area-D which is recommended for clearance to depth.

2.9.2.1 An interim removal action surface clearance was performed as an interim action removal action in the dog kennel area to allow the area to be used by Homeland Security to house dogs used in the canine training program. The JPA currently leases the site to Auburn University who operates the canine training program. Land use controls were instituted to

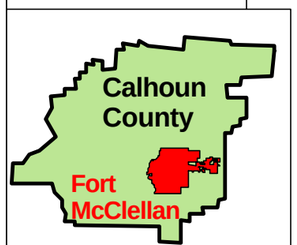
prohibit intrusive activity and to require ordnance familiarization training for workers and visitors. The work was completed between May 24-26, 2004. One piece of munitions debris, approximately 1/3 of a 37mm armor piercing tracer round, was certified inert and removed from the site. Additionally, 100 pounds of non-munitions related scrap was removed. The USAESCH issued an Interim Action Statement of Condition on June 9, 2004. The interim action response action was documented in the June 25, 2004, *Final Letter Report, Task Order 22, Time Critical Removal, Bravo Area Dog Kennels*.

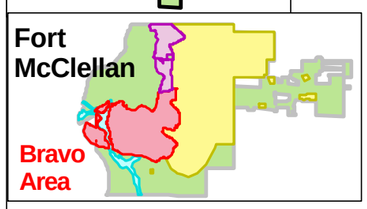
2.9.3 Water Tank Construction Sites

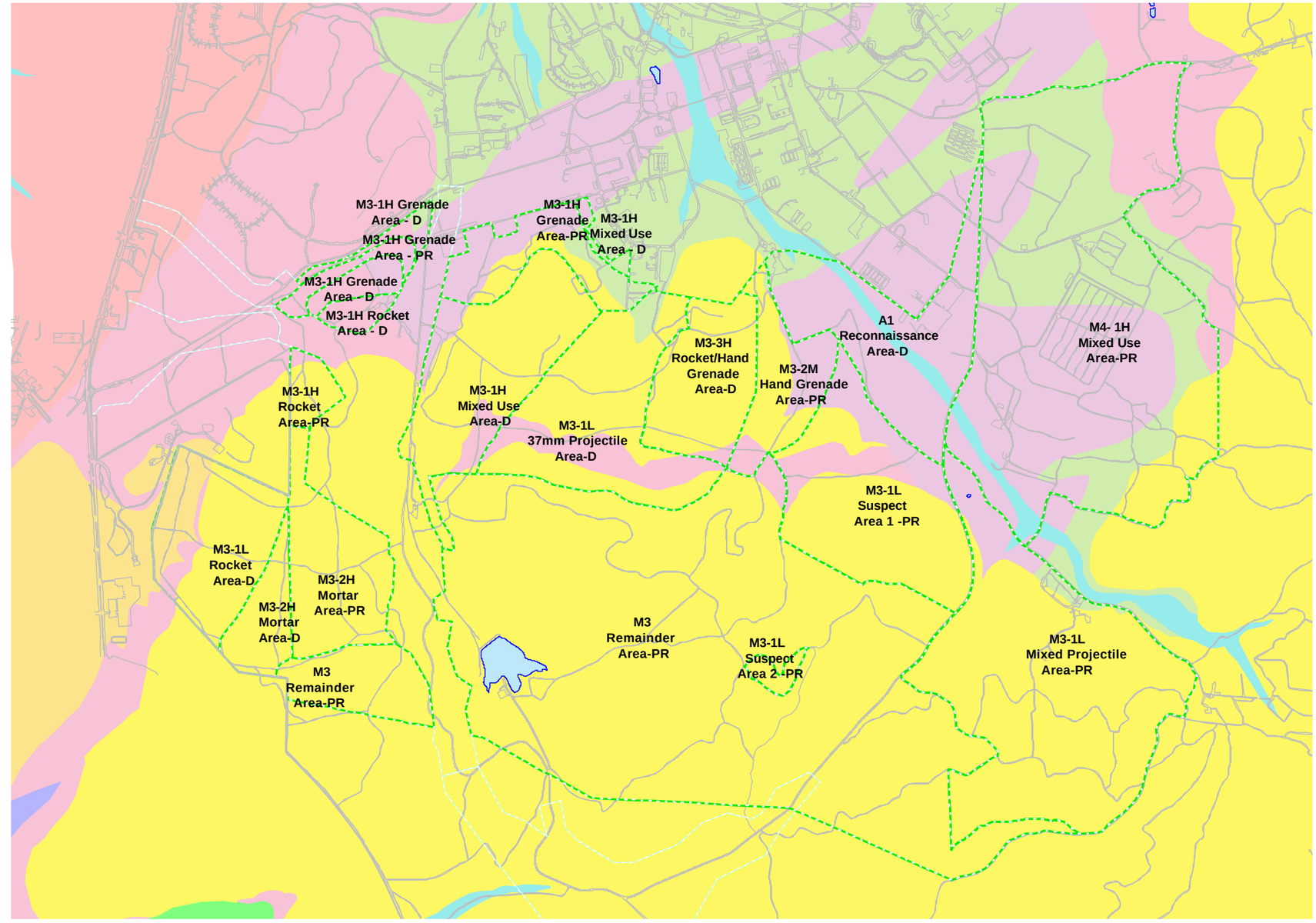
The Water Tank Sites, located within the Bravo Area, are three separate sites designated as Sites A, B, and C. These sites have a combined area of approximately 19.08 acres. Site A is located mainly within M3-1H Mixed Use Area-D and partially within M3-1H Grenade Area-PR. Sites B and C are located within M4-1H Mixed Use Area-PR. Figure 2-3 depicts the location of the water tank construction sites within the Bravo Area.

2.9.3.1 An interim removal action was performed at these sites to prevent conflicts or delays with construction of new water towers within the Bravo EE/CA area. The work was completed in sequential steps of site preparation: brush clearing, geophysical survey, and intrusive operations between December 2003 and May 2004. Intrusive investigation of anomalies resulted in the excavation of 18 OE items, 1,141 pounds of OE Scrap, and 18,323 pounds of Non OE Scrap. The final report is in Final form and a statement of clearance was issued in June 2006. The response action was documented in the May 2006 *Final Site Specific Final Report for the Water Tank Construction Sites*.

THIS PAGE INTENTIONALLY LEFT BLANK.







0 1000 2000 3000 4000 5000 6000

SCALE: 1" = 2000'

TETRA TECH EC, INC.

Legend

Bravo Sectors

Bypass ROW Area

Fort McClellan

Roads

Lakes/Ponds

Geology by Type

Chilhowee Group undifferentiated

Colluvium - age unknown

Conasauga Formation

Limestone - age unknown

Mississippian/Ordivician - Floyd & Athens Shale, undifferentiated

Ordovician - Little Oak and Newala Limestones

Quanternary - alluvium

Rome Formation

Shady Dolomite

Terrace Deposit - age unknown

Figure 2-2

BRAVO AREA Geology

Fort McClellan, Calhoun County, Anniston, Alabama
December 2004

THIS PAGE INTENTIONALLY LEFT BLANK.

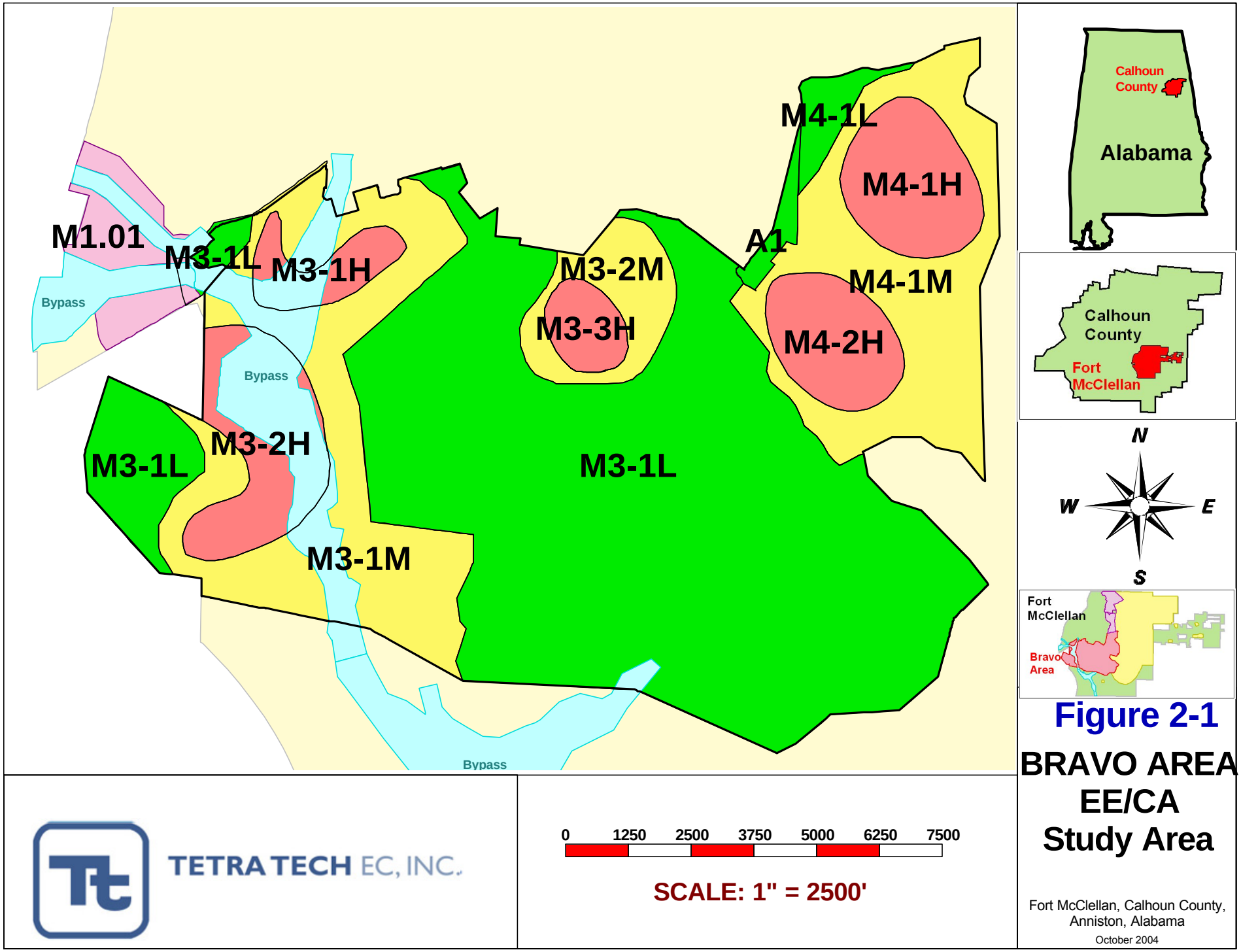


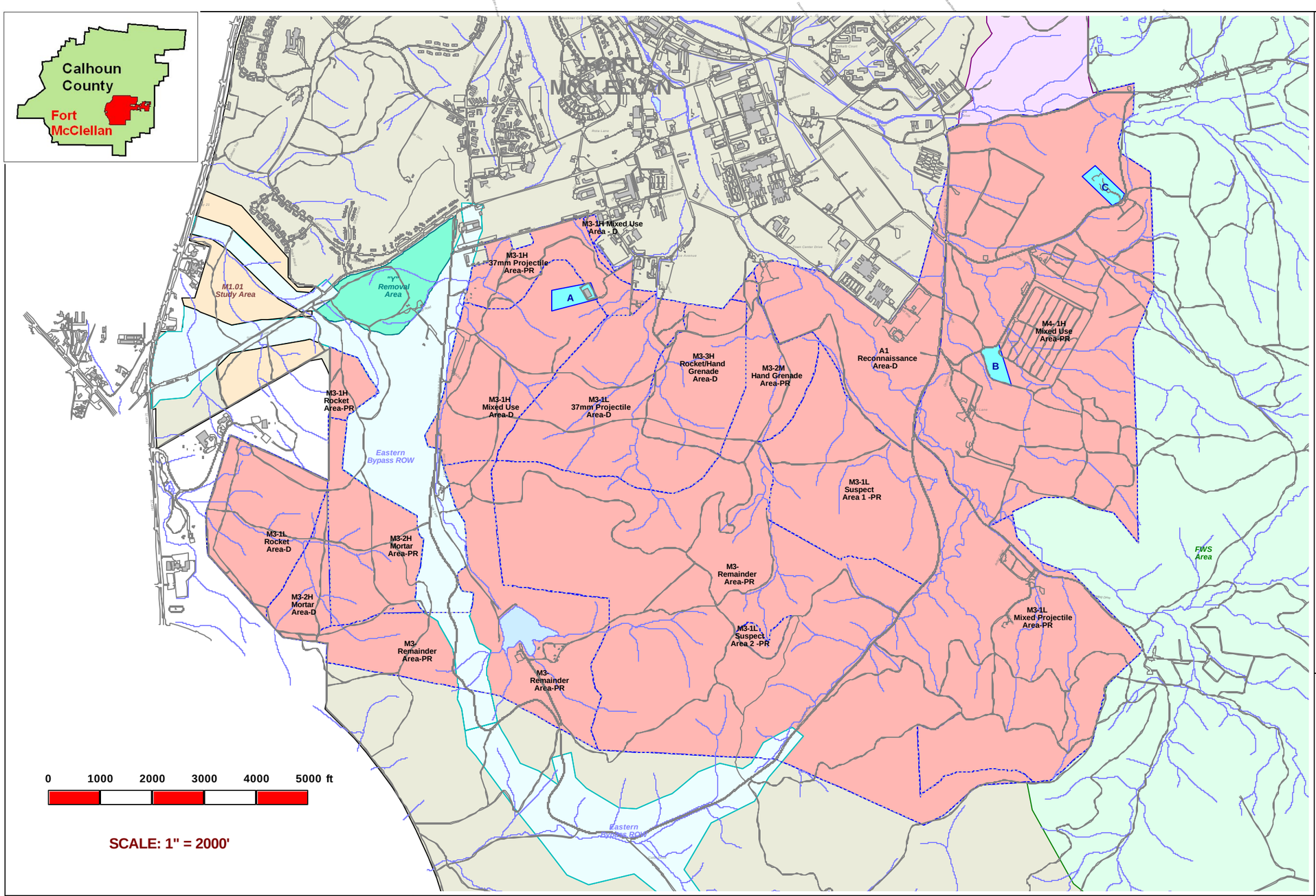
Figure 2-1

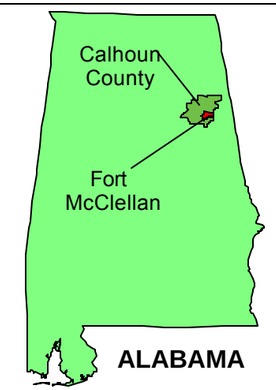
BRAVO AREA EE/CA Study Area

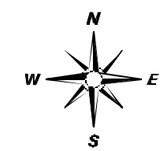
Fort McClellan, Calhoun County, Anniston, Alabama

October 2004

THIS PAGE INTENTIONALLY LEFT BLANK.







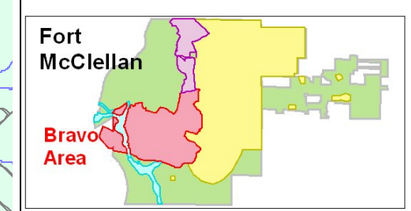


Figure 2- 3

Water Tank Site Locations Overview

Fort McClellan
Calhoun County
Alabama

April 2006

TETRA TECH EC, INC.

Legend

- Water Tank Sites
- "Y" Removal Area
- M1.01 Study Area
- Bypass ROW
- Bravo Area and Sectors
- Alpha Area
- FWS Area
- Fort McClellan

THIS PAGE INTENTIONALLY LEFT BLANK.

3.0 SITE CHARACTERIZATION

3.1 GEOPHYSICAL VALIDATION PLAN

Validation and testing of equipment, processing and interpretation, anomaly reacquisition, and field personnel were performed prior to and during the Bravo EECA at Fort McClellan. No official Geophysical Prove Out (GPO) was conducted as part of this Task Order. Instead, the Geophysical Prove Out was part of the procurement effort in the selection process for the contract and no formal report was required. The USAESCH Geophysicist's summary of TtEC was that 33 of the 40 seeded items were detected by TtEC. Further, the location accuracy for 28 of these items was within 0.5 meters; with the final 5 items being within 1 meter. The depth accuracy of TtEC was 20 items determined within 10 cm of the actual depth. Similar results were achieved for the non-seeded "real ordnance items" located within the evaluation grid.

3.1.1 This evaluation was performed before the 11X depth rule was determined and most (if not all) of the non-detected items were buried below this 11X depth. The results of this performance evaluation is what led USAESCH to further investigate these results to see if this relationship of depth of detection was consistent across the sites located in the contiguous United States. Analysis of the additional sites revealed that this is indeed a technological limitation with the currently available commercial detectors and was used to develop the current minimum required depth of detection standard for the contract Geophysical DID.

3.1.2 Equipment and personnel were validated at "test sites" at Fort McClellan: USACE Functional Check Area adjacent to Range 16 USACE GPO parcel; TtEC trailer Complex; Soccer Field Complex; and the M101 Parcel. These validation efforts were performed to ensure that the data acquisition methodology and spatial sampling protocols, sensor(s) and positioning equipment, acquisition methods, and data analysis and management systems provide data that are of sufficient quantity and quality to meet the project objectives. Further details on TtEC data validation are included in Appendix D.

3.2 QUALITY CONTROL

The Final Site Specific Work Plan Bravo Area EE/CA, April 2001 (SSWP), Section 11 discussed the quality control process that was implemented for work the Bravo Area. Quality Control was conducted using a three-phase control process - preparatory, initial, and follow-up inspections and/or audits to ensure processes were in control and opportunities for improving processes were captured and implemented.

3.2.1 During the preparatory phase, personnel were trained under the direction of a senior geophysicist in the proper use and operation of the equipment. Each operator was well trained on the use of hand held instruments prior to going into the field. Additionally, other measures listed in the SSWP required for the preparatory phase inspections were performed.

3.2.2 An initial phase inspection was performed the first time a definable feature of work was performed to check the preliminary work for compliance with procedures and contract specifications.

3.2.3 The follow-up phase inspections were performed on a scheduled and unscheduled basis to ensure a level of continuous compliance and workmanship. The Site QC manager was responsible for performing inspections and surveillance to ensure work was in compliance with the scope of work and the work plans, to ensure maintenance of the required level of workmanship, to ensure log books were filled out and maintained properly, to ensure proper data management, and to check the "false positive" anomalies. Intrusive data validation in the grids and transects was performed by the team leader who ensured the item dug was appropriate to the signal detected. Also, he verified that the identification of items was correct.

3.2.4 Each day the hand-held instrument's sensitivity was tested in the equipment test plot located at the back gate of building 215. Daily testing was required by the General Site-Wide Work Plan for OE Response, September 2000. The Schondstedt detector, which was used in the supplemental transects, has been shown capable of detecting to depth common MEC items found on FTMC.

3.2.5 The specific QC activities performed during the preparatory phase, initial phase inspection, and follow-up phase inspection were documented on QC Surveillance Reports which were attached to the Daily QC Reports. Those reports as well as field logs for the work performed prior to the Supplemental Transect work were recorded on compact disks (CDs) but they were not required to be included in the EE/CA report. Logbooks QC Surveillance Reports, and Daily QC Control Reports containing information on work and Quality Control done in the supplemental transects are provided in Appendix F.

3.3 QUALITY ASSURANCE

Quality Assurance (QA) procedures performed by the USAESCH for geophysical work are documented in the Quality Assurance Audit Evaluation located at Appendix E. For the mountain and supplemental transects USAESCH performed QA of the process. The USAESCH Safety Specialist observed the dig teams to ensure they followed transects and adhered to mag procedures. The QA process for the supplemental transects is described in the Quality Assurance Surveillance Plan (QASP) dated May 19, 2004, as provided to ADEM by E-mail on May 21, 2004. The USAESCH Safety Specialist was required to document surveillance activities on Quality Assurance Reports (QAR) and nonconformance or violations on either Corrective Action Requests (CAR) or CEHNC Form 948.

3.4 DEVIATIONS FROM APPROVED WORKPLANS

A General Site-Wide Work Plan was developed to support the characterization of suspected contaminated areas within Fort McClellan. The General Work Plan described the technical approach and management structure for the completion of the Fort McClellan field program. The plan addressed OE investigations, removal actions, anomaly avoidance during HTRW activities, and construction support requirements. This General Work Plan was submitted as Final on August 14, 2000. The General Site-Wide Work Plan was supplemented by Site-Specific Work Plans, which were developed for individual areas within Fort McClellan (Foster Wheeler, 2001).

3.4.1 A Site-Specific Work Plan was written for the Bravo Area EE/CA investigation. The site-specific plan addressed the project management structure, overall approach to the EE/CA

Process, site characterization planning and operations, OE planning and operations, site health and safety, environmental protection, data management, and UXO quality control. ADEM concurredwith the Final Bravo Area EE/CA Work Plan by letter dated October 12, 2001 (Foster Wheeler, 2001).

3.4.2 TtEC produced an addendum to the Bravo Site-Specific Work Plan. The purpose of the addendum was to describe additional transect sampling to be performed in the M3-Remainder Area-PR. TtEC developed the addendum in conjunction with ADEM representatives at a meeting on February 6, 2004. The Final Addendum was submitted on June 4, 2004 (TtEC, 2004) and ADEM concurred by letter dated June 29, 2004.

3.4.3 The purpose of this paragraph is to clarify changes or deviations from the original work plans during the actual site characterization of the Bravo Area.

3.4.4 Section 5.4.5, Data Resolution or Line/Grid Width Requirements, of the General Site-Wide Work Plan states: "The spatial sample density required to detect a target at a specific depth is one of the most important considerations in survey planning. In general, our past experience has shown that to detect small, shallow targets (e.g., 20mm) with the EM61 requires a line spacing of 1.5 to 2 feet and instrument recording interval of 6-8 times per second. If necessary, a simplistic test can be performed prior to specific task orders to determine the line spacing and spatial sample density necessary to detect an OE item(s)of interest." This is a general statement that basically means to detect very small items a high sample density is required. The excerpt from the Site-Wide Work Plan was based on the example of a 20mm projectile. In the Bravo Area, a MKII hand grenade/37mm projectile was the actual smallest item of interest used for planning, not a 20mm projectile.

3.4.5 TtEC Corporation geophysicists implemented a test program at the Fort McClellan site in June, 2000.

3.4.6 The purpose of the test program was to determine acceptable line spacing based on a MKII grenade, as well as verify response characteristics of EM61 system, and evaluate the response characteristics of a MKII grenade at different lateral offsets from the center of the EM61 coil. An additional objective was to evaluate EM61 time gate selection (660 microseconds (us), 346us) for the program objectives. The data from the test suggests that line spacing should be no greater than 3 feet to meet project objectives with the 346 us time gate. Therefore, a line spacing of up to 3 feet is acceptable. Due to the rough terrain, extensive vegetation, and obstacles in most of the survey areas, a line spacing of 2.5 feet was implemented as a conservative measure for navigation of transects in difficult terrain.

3.5 EE/CA INVESTIGATION

TtEC performed a site characterization for conventional ordnance from April 2001 to August 2002 to support the EE/CA for the Bravo Area. The investigation included geophysical investigations and intrusive OE investigations. A detailed description of the procedure used to select areas for investigation is provided in the Final EE/CA Work Plan (Foster Wheeler Environmental, 2001a). The Army involved the BCT in the preparation of this work plan in order to gain their concurrence. Below is a summary of the investigation approach employed at the site.

3.5.1 Overview of Investigation Approach

Prior to developing the sampling plan for the EE/CA areas at Fort McClellan, TtEC performed a thorough review of the documents discussed in Chapter 2.0. Information such as locations of firing ranges, firing points, and other training areas was compiled onto a current topographic map (refer to Figure B-1 in Appendix B) of the area. Aerial photographs were reviewed to identify suspect areas not specifically outlined in the historical records.

3.5.1.1 For the ordnance expected at Fort McClellan, impact areas are composed of target zones, firing miss zones, and fragmentation zones. The size of the target zone depends on the type of ordnance and the delivery mechanism. As shown in Army Regulation 385-63, target zones are surrounded by firing miss zones that are typically larger in the direction of fire (up to several hundred feet) and lesser to the sides. Further, a fragmentation zone exists beyond the target and firing miss zones that can extend over 1000 feet beyond the edge of the target zone depending upon the fragmentation distance of the munition. For the purposes of this EE/CA, TtEC has concentrated on locating, evaluating, and recommending appropriate response actions for the target and firing miss zones of the ranges. These areas carry the most significant likelihood of containing unexploded ordnance (UXO). Within the fragmentation zone, various parts and fragments of the munitions have been used as indicators that the target zone is somewhere in the vicinity. Since the fragments pose no hazard to the public, they have not influenced the evaluation or recommendation of response actions for the areas. The areas that are recommended for clearance should include the target and firing miss zones. The provisions in the recommended alternatives for clearance of these areas will include a 200-foot buffer area clear of UXO to ensure that the complete target and firing miss zones have been identified and cleared. Because the fragments pose no hazards to the public, the fragmentation zones have been excluded from the areas identified for clearance. If a UXO item is identified within the buffer area, the boundary will be extended and the area investigated to ensure a 200-foot buffer that is clear of UXO.

3.5.1.2 Within the target and firing miss zones, there will be a large number of fragments found from the impact and detonation of munitions from training exercises. Within the fragmentation zones, the number of fragments will generally become more sparse. For example, the detonation of one 81mm M43 produces 3,186 fragments within 1,097 feet of the detonation. About, Eighty percent of these (2,549 fragments) are expected to be within 616 feet of the detonation. As shown in Figure 3-1 at the end of this chapter, the detonation of this mortar results in 155 fragments/acre within 218 feet of the detonation, 82 fragments/acre between 218 feet and 371 feet from the detonation, 67 fragments/acre between 371 feet and 616 feet from the detonation, 28 fragments/acre between 616 feet and 895 feet from the detonation, and 1.3 fragments/acre between 895 feet and 1,097 feet from the detonation. These values are characteristic of the detonation of a single item. A target is fired upon multiple times. As part of routine training, a crew would typically fire no less than 18 rounds per day. Therefore, the estimates of the number of fragments/acre would be larger for multiple detonations.

3.5.1.3 EE/CA sampling results, in some instances, revealed an isolated ordnance item not located within a target area, firing miss zone, or training area. These items appear sporadically in various locations within the Bravo Area and cannot be related to any target or training area. It is not possible to locate individual ordnance items on Fort McClellan without clearing 100% of

the land. Figure 3-2 located at the end of Chapter 3.0, presents a Conceptual Impact Area for an 81mm.

3.5.1.4 The Eastern Bypass right-of-way, which bisects the Bravo Area, was not sampled as part of the Bravo EE/CA. The acreage in the Eastern Bypass right-of-way was included in a separate removal project. However, data collected within the Bypass area was considered during assessment of sectors in the Bravo area that are adjacent to the bypass. Four UXO items, which were less than 100 feet from the western boundary of M3 Remainder Area-PR, were identified during the Eastern Bypass Removal Project. These items were Grid R54, which contained a 60-mm High Explosive (HE) mortar; Grid R51, which contained a 3-inch Stokes mortar; Grid R48, which contained a 3-inch Stokes mortar; and Grid C85, which contained a 40-mm HE projectile. To address Grids R54, R51, and R48, a 200-foot buffer was extended from the location of the item into the Bravo Area. This "buffer" area was included as part of the M3-1H-Mixed Use Area – D sector. Actions to address Grid C85 are discussed in Chapter 16. Additionally, sampling data collected by Parsons Engineering Science (Parsons) during RCWM EE/CA (Parsons, 2002) was provided to TtEC for use in this EE/CA. This data was collected in the area referred to as the Old Burn Pit, located in the northern portion of Sector M3-1L. OE items discovered by IT Corporation have been reported to TtEC on data sheets and integrated into the database used for assessing Bravo sectors.

3.5.1.5 Following a review and compilation of historical ordnance information, TtEC performed a ground reconnaissance of the areas thought to contain ordnance items. Areas designated for reconnaissance were based on historical range locations, firing point locations, and topography. Topography is important since mountainsides adjacent to range firing points may have served as backdrops for artillery firing and other ordnance training. Reconnaissance transects were walked by teams of three personnel each. Each team searched for ordnance items on the ground surface as well as other surface features related to ordnance activities such as target materials and craters, both visually and with the aid of a Schonstedt metal detector. The metal detector assisted in identifying items covered by leaves or other heavy vegetation. The teams also recorded information concerning topography and vegetation. TtEC used this reconnaissance data to design appropriate sampling plans for the EE/CA areas.

3.5.2 Selection of Areas of Investigation

The ASR and other pertinent documents were examined to determine location and orientation of range fans, areas of overlapping historical range fans firing points, and topographic features potentially used as backstops. The document review yielded suspect areas that were interpreted as likely to contain OE contamination. In Appendix B, Figure B-1 shows range fan outlines obtained from the ASR combined with sector outlines used for the EE/CA sampling program. These range fan outlines indicate areas potentially containing OE contamination. Areas of overlapping range fans, and suspected impact areas within the central portions of range fans, were areas considered likely to contain a greater amount of OE contamination. The field reconnaissance effort concentrated in these areas to determine if the historical data indicating likely OE impact areas could be confirmed with OE indications seen on the ground. The field reconnaissance effort also focused on areas outside of probable impact areas (but still within range fan outlines) and some suspect areas between known range fans.

3.5.2.1 Results of the field reconnaissance were analyzed and combined with the historical documentation and topographic features to create a basis for a sampling plan for EE/CA investigation. Characterization sectors were defined based on the expected likelihood of OE being present. Each Bravo Area was expected to represent an area of like future use, given the presence of Bravo Area within the redevelopment area. Each Characterization Sector was classified as having a "High", "Medium", or "Low" likelihood of OE presence based on the available information. The basic criteria used in this determination were:

- High Likelihood – This designation was applied to: suspected impact areas within range fans; areas of multiple range fan overlap; locations where field reconnaissance confirmed multiple and frequent OE items or indications of OE presence (e.g., targets, impact craters).
- Medium Likelihood – This designation was applied to areas within or directly adjacent to range fans that had the potential to contain OE, but were outside the suspected main impact areas; areas where the available evidence of impact was somewhat contradictory; areas that were the buffer zones between "High Likelihood" and "Low Likelihood" areas; locations where field reconnaissance revealed occasional OE items or indications of OE. "Medium Likelihood" areas are expected, based on field reconnaissance and historical information, to potentially contain some subareas within them where OE is present and some subareas within them where OE is not present. One goal of the EE/CA sampling was to characterize and identify the portions of a "Medium Likelihood" sector where there was likely to be OE present and where OE is not likely to be present. This is so the areas can be more effectively assessed and evaluated with respect to the type and amount of further response that is warranted.
- Low Likelihood – This designation was applied to areas at the outer edges or ends of range fans; areas outside of known range fans; and locations where field reconnaissance revealed only very sporadic OE items or no OE items.

3.5.2.2 Due to the relative lack of quantitative information about the amount of OE likely to be present within any specific portion of Bravo Area, specific threshold values of OE density on numbers of OE items were not used to establish the boundaries of the areas of the Characterization Sectors. The sector boundaries were established using location-specific historical and field reconnaissance data, consideration of the topography and soil type (as they relate to the likely distribution of OE with depth in the soil), professional judgment, and site familiarity. Applying these considerations, Bravo Area was divided into ten separate Characterization Sectors: M3-1L, M3-1M, M3-2M, M3-1H, M3-2H, M3-3H, M4-1L, M4-1M, M4-1H, and M4-2H (see Figure 2-1 located at the end of Chapter 2.0). The sampling plan for each Bravo Area Characterization Sector was then designed, taking into account the extensive review of historical information and the observations made during the field reconnaissance. This approach for establishing the Characterization Sector boundaries, including the factors being considered, the data being used, and the logic that was applied, was presented to the BCT to gain concurrence. More details concerning the defining of the EE/CA Characterization Sectors is contained in the approved Final Site-Specific Work Plan for the Bravo Area (Foster Wheeler Environmental, 2001).

3.5.3 Determination of Sampling Acreage

The tool used to calculate a baseline amount of acreage required to be sampled in an Area of Investigation (AOI) for Fort McClellan was UXO Calculator. UXO Calculator was developed by Dr. Bruce Barrett of the University of Alabama, Tuscaloosa. The procedure for generating a sampling size given data quality and decision support requirements for an AOI is closely akin to acceptance sampling plans in use by the Government and industry for over sixty years (e.g., MIL-STD-1916). Basically, these acceptance sampling approaches calculate a minimum amount of sampling required to meet certain criteria, including target values and confidence levels. To do this, it is necessary to select a benchmark target value of UXO density to orient the sampling program in order to determine when sampling is adequate to draw a conclusion at a certain confidence level (such as 90% as used at Fort McClellan). The target values considered for this sampling were 0.1 UXO/acre for areas of significant public use, 0.5 UXO/acre for moderate use, and 1.0 UXO/acre for minor use. These are normally agreed upon prior to sampling so that reasonable sample sizes may be generated for site characterization. The minimum sample size required is generated for the assumption that no UXO will be found. This serves to initiate a field sampling program. If UXO are actually discovered, the plan is then modified to require further sampling to reach the same degree of confidence in the results.

Once the boundaries of the Characterization Sectors were established, calculations using the UXO Calculator were performed to estimate the amount of sampling needed to characterize each sector. This acreage also was apportioned between acreage to be characterized using grids and acreage to be characterized using transects. The baseline amount of sampling to be performed in Bravo Area during the site characterization portion of the EE/CA was estimated using the UXO Calculator tool. The UXO Calculator is a statistical sampling tool that, given certain assumptions, calculates the minimum number of acres that must be investigated at an OE site to characterize it at a specified level of confidence and specified OE density. These UXO Calculator estimates were used as a guideline for the Bravo Area characterization Work Plan. The Characterization Sectors were areas that were judged to be internally similar with respect to the likely presence of ordnance within them, similar mechanisms for ordnance release into the environment (based on the original conceptual site model developed for each characterization sector), and similar types of ordnance that have been shown to have been found in or were associated with the activities conducted in that area. The Minimum Discrimination Module of the UXO Calculator was used to estimate how much acreage would need to be sampled within each of these overall Characterization Sectors to be able to demonstrate that a specified OE density value was not exceeded if no OE was found during the sampling effort. Under this specific assumption (i.e., no OE item finds coupled with the pre-sampling work done to define the Characterization Sector boundaries), the area homogeneity requirement for application of the UXO Calculator statistical relationships would be valid for use of this approach for estimation purposes.

3.5.3.1 The Minimum Discrimination Module of the UXO Calculator requires as inputs for this estimation: the overall size of the Characterization Sector; the OE target test density (i.e., the number of hazardous OE items per acre to be used as a benchmark); and the desired level of confidence in knowing if this benchmark OE density value is exceeded or not. The calculations are performed that identify the number of acres that must be investigated within the sector to be able to support this determination. An OE target test density of 0.1 OE/acre was selected as

being an appropriate basis for designing sampling programs in areas with the same type of land use and redevelopment activities that are projected for Bravo Area. This target was applied to all the Characterization Sectors classified as "Low Likelihood" or "Medium Likelihood" (i.e., five of the ten sectors). A higher OE target test density of 1.0 OE/acre was applied to the other five Characterization Sectors that were classified as "High Likelihood". Another module of the UXO Calculator that is appropriate for situations where some number of OE items is expected to be found was used for these calculations. This target test level was judged to be more appropriate to confirming that OE was in fact present in an area that was either already known or strongly suspected of containing hazardous OE. A 90% confidence level was specified for the calculations for all of the sectors. Using these inputs, a minimum of 143.5 acres of investigation and intrusive activity was found to be necessary for the ten Characterization Sectors listed above. Each of the Characterization Sectors classified as "Low Likelihood" or "Medium Likelihood" generally required from 20 to 43 acres of sampling, while each of the Characterization Sectors classified as "High Likelihood" generally required from 2.5 to 3.5 acres of sampling. This amount of sampling was then earmarked to be collected through either grids or transects. Typically, the required acreage in the "High Likelihood" sectors was earmarked for ½ acre grids, while the "Low Likelihood" or "Medium Likelihood" sectors were to be investigated using larger acre grids and/or transects.

3.5.4 Placement of Grids and Transects

Within each sector, 80 percent of grid locations were selected at random and 20 percent were selected using the professional discretion of the EE/CA Project Team in consideration of a set of pre-specified criteria. Random grids were selected with a random number generator and Geographical Information System (GIS) tools. Areas within each sector that were less than 40 degrees in slope were overlain by a uniform network of potential sampling grids. Each grid was assigned an identification number and tagged. Externally generated random numbers were then used to select the sampling grids. From the random samples, a center point was established from which coordinates were generated and used for surveying in the sampling grid locations. Randomly selected grids that fell partially outside of the Characterization Sector were shifted the minimum distance necessary to bring them within the sector boundary. A limited number of the grids were relocated due to terrain features such as ponds or wetland areas.

3.5.4.1 Discretionary grids were placed in areas to either clarify or confirm the findings of prior reconnaissance work or the results of the archive search. Grids were placed 1) in areas where ordnance was found during field reconnaissance; 2) in areas where known range fans or suspect training areas were historically located; 3) along topographic features which may have served as a backstop for firing of artillery; 4) in areas along sector boundaries to determine if those boundaries between probable areas of differing OE presence are appropriately located; and 5) to fill in larger gaps in coverage where no randomly selected grids happened to fall. The approved Site-Specific Work Plan for the Bravo EE/CA shows which grids were placed as random versus discretionary grids.

3.5.4.2 Three types of transects were used during data collection in the Bravo Area: Data Collection Transects (or clusters), Delineation Transects, and Mountain Transects (see Figure 3-3). Each Data Collection Transect (or cluster) consisted of a series of 200-foot long, parallel segments 25 to 50 feet apart. The segments were established and then walked for data collection. Delineation transects were placed over areas suspected of containing a high density of OE to

further define the extent of these areas. Delineation Transects were basically straight segments approximately 3.5 feet wide and with varying lengths with transect spacing set at approximately 500 feet. Several Delineation Transects would be established in a particular area in a north-south and east-west grid-like pattern and walked for data collection. Field teams were given some discretion to depart from the exact pre-determined path, as long as the general direction of each transect was maintained and the transects covered the interior and edges of the suspected high-density area as planned. Some discretion meant that if the path of the transect was in line with a large tree or other obstacle, the team could go around the tree or if the path would require the team members to have their left foot on a rock wall and their right foot on the ground; they could move the location of the transect slightly to the left or right to avoid the obstacle.

3.5.4.3 Mountain Transects were laid out in areas containing slopes greater than 40 degrees. Transects were placed in order to achieve a wide geographic distribution across mountainsides that may have been used as backstops for artillery firing. The initial mountain transect paths (Mountain Transects T01-T24) were 15 feet in width, and generally followed contours across the flanks of the mountains, with one to three transects placed across each significant mountainside. In general, slightly more transect mileage was placed on the northern and eastern flanks of the mountain range, since most known ordnance firing points were located north and east of the crest of the Choccolocco Mountains. The supplemental mountain transects (Mountain Transects T25-T65) that were investigated in an addendum to the site characterization were 5 feet wide and each segment was 290 feet long.

3.5.4.4 During the course of fieldwork, TtEC proposed that the planned data collection transects (or clusters) for Sector M3-1L be replaced with grids (75 replacement grids). Please refer to Figure 2-2, located at the end of Chapter 2.0, for the location of sector M3-1L. Work in Data Collection Transects had begun in the western portion of Bravo. However due to excessively dense vegetation in this sector, UXO personnel were experiencing great difficulty in clearing brush, collecting data, and completing of each cluster. The large amount of clearance work required just to begin work in each cluster caused many delays in the fieldwork schedule and the cumulative delays expected to complete the remaining clusters would have significantly delayed completion of the Bravo characterization. TtEC discussed these issues with USAESCH personnel, who visited the area to better understand the problems that the UXO teams were experiencing. TtEC, with agreement from USAESCH, proposed replacing the clusters with 75 grids. The proposed changes were presented to the BCT in August 2001 with assurance that the changes would provide for the same amount of sampling but with a different distribution and location. The BCT agreed that for the low-density areas, as long as the data quality objectives remain the same, the modification to grid sampling versus transects was approved. The replacement grids established following the scope change were surveyed and laid out as half-acre grids. But, geophysical data was collected over the entire 0.5-acre grid. The 75 replacement grids are the 500 series-numbered grids that are now located in sectors M3-Remainder Area-PR, M3-1L-Mixed Projectile Area-PR, M3-1L-Rocket Area-D, M3-1L-Suspect Area-PR, M3-1L-37mm Projectile Area-PR, and portions of M3-1H Mixed Use Area-D, M3-3H Rocket/Hand Grenade Area-D, and M3-2M Hand Grenade Area-PR.

3.5.5 OE Sampling Procedures

3.5.5.1 Site Preparation

Site preparation of work areas included surface clearance of OE and other metallic scrap from grids and transects, brush removal, and land surveying of grids and transects. UXO teams conducted a visual surface clearance of grids to support land surveying and geophysical mapping. Any metallic scrap on the surface was removed to prevent interference with geophysical instruments. OE and OE Scrap items found on the surface were identified, recorded in the database, and either removed or destroyed in place in accordance with the workplan. Depending on the planned sampling method for a work area, the surface clearance team makeup varied. For grid preparation, each surface clearance team consisted of a UXO Technician III team leader accompanied by five UXO sweep personnel aided by Schonstedt or Whites metal detectors. In transects, surface clearance was accomplished by UXO II and/or UXO III Technicians on each transect team in conjunction with transect navigation, brush cutting, and preparation for geophysical data collection. Surface clearance in the mountain transects was performed simultaneously by UXO Technicians with navigation and data collection activities. A total of approximately 169 acres in the Bravo area were surface cleared of UXO, OE, OE Scrap, and Non-OE Scrap by TtEC prior to geophysical data collection.

3.5.5.1.1 TtEC made significant OE discoveries during surface clearance activities. Approximately 75 OE items were found during surface clearance activities, as well as numerous OE Scrap items. Please refer to each sector specific table of items found (Tables 8-1 through 24-1) for a listing of items found during surface clearance activities.

3.5.5.1.2 Gas-powered hand tools (e.g., chain saws, weed eaters, hedge trimmers) were used to clear work areas of vegetation. Tree removal or pruning was conducted on a case-by-case basis when required to complete work in a grid. For the supplemental mountain transects, the work plan addendum stated that no brush clearing would be required. Brush clearing was performed only to the extent determined necessary by the field crews. The Schondstedt was used because it could be inserted under bushes to pick up anomalies, thereby eliminating the necessity to perform extensive brush clearance.

3.5.5.2 Geophysical Data Acquisition

Following surface clearance and removal of brush from each grid and transect, geophysical data was collected to identify metallic subsurface items. Geophysical data were acquired using two-dimensional (2D) grid and one-dimensional (1D) transect methodologies. The Digital Geophysical Methods (DGM) Validation Plan at Appendix D provides the details of testing and validation efforts for the geophysical sensors and positioning equipment, data acquisition methodologies, personnel training, and overall approach used for the Bravo EECA. One of the specific 1D transect approaches involved acquisition personnel using EM61 in “sweep” mode. In order to accomplish this activity in the best possible manner, the acquisition personnel were trained in the field by a senior geophysicist, and the EM61 electronics were nulled in the field as per the pre-task training effort. The nulling procedure involved turning the volume all the way up and then nulling the bottom coil until the instrument "hum" could not be heard by the instrument operator, and then slowly turning the nulling dial "up" until the "hum" of the

instrument was just audible. This procedure helped ensure a level of consistency between the different teams

3.5.5.2.1 Geophysical data were collected using the EM61 in grids, data collection transects (or clusters), and delineation transects. EM61 geophysical data were digitally recorded in the field, processed, and interpreted to formulate digsheets for intrusive investigation personnel in 209 grids (134 original and the 75 replacement grids in M3-1L). EM61 geophysical data were digitally mapped and processed in 145 data collection transects (clusters), but the intrusive investigation of the anomalies was based on flagging audible anomalies during acquisition and digging the flagged locations as described in section 6.6.3.2.4 of the SSWP (April 2001). Of the 145 clusters that were geophysically mapped and processed, 103 were interpreted by a senior geophysicist and the dig sheets were formulated. Nineteen of the mapped clusters, located in Sector M3-1L Rocket Area-D, were not processed further due to boundary issues. Intrusive investigations could not be conducted in these nineteen clusters due to their location near the Fort McClellan boundary because exclusion zones would have extended off site into public property and Highway 21. Therefore, the process of interpreting these clusters was not completed. In the remaining twenty-three mapped clusters, the teams excavated the flags placed in "real time" and did not utilize the interpreted geophysical data. Therefore, these were investigated using the Mag and Dig approach.

3.5.5.2.2 Forty-one of the originally planned 186 clusters were not geophysically mapped due to the presence of 40mm items and were considered sufficiently characterized for the EE/CA. Prior to making this determination, twenty-one of these clusters had been investigated with an EM61 and the data is included in the database. The EM61 was used in "sweep mode" by field personnel in lieu of digitally recording the instrument signal and processing and interpreting the resulting data. For the 1D transect cluster method, audible anomalies emitted by the EM61 were flagged in the field as they were encountered during data collection (digital geophysical data were not recorded). 1D transect data collection within clusters involves collecting data along a pre-defined route between "waypoints". These waypoints exist between "end points" that have been location surveyed. Per the Work Plan for this EE/CA, the intrusive investigation locations for these twenty-one clusters were determined based on the audible instrument response in "real time" rather than processed/interpreted digital geophysical data. These clusters are located in Sectors M3-3H Rocket and Hand Grenade Area-D and M3-2M Hand Grenade Area-PR.

3.5.5.2.3 For the twenty-one clusters, the one-dimensional (1D) transect data were collected using an EM61 high-resolution metal detector used in "sweep" mode. The 21 clusters are:

- M32M300 through M32M305, M32M313, M32M314, M32M317, and M32M326 through M32M347 located in M3-3H Rocket/Hand Grenade Area-D; and
- M32M348 through M32M357 located in M3-2M Hand Grenade Area-PR.

3.5.5.2.4 Digital geophysical data were not recorded along the original mountain transects nor in the supplemental transects. In the Mountain Transects, geophysical data was acquired using a White's metal detector over a 3-4 foot wide swath within a fifteen foot wide transect. Anomaly counts were based on field crews manually recording the number of audible signals heard (i.e., sweep mode) in 290 foot segments of each transect. The table of audible signals is in Appendix F. Crews investigated/dug one anomaly in each segment. If there were no audible signals in a segment, the crew dug two anomalies in the next segment. In the supplemental Mountain

transects, geophysical data was acquired using a Schondstedt hand-held locator. All anomalies were investigated/dug. The supplemental transects were five feet wide and each segment was 290 feet long.

3.5.5.2.5 Grids were surveyed by TtEC in the Bravo Area using an Ultra-Sonic Ranging and Data System (USRADS) for positioning and an EM61 high resolution metal detector to acquire digital geophysical data. The oversized grid method was utilized for geophysical data collection in the grids (with the exception of grids within Sector M3-1L). The oversized grid method is simply that if a planned one-acre grid contained obstructions within its boundaries that reduced the acreage that could be geophysically mapped; then the overall boundary of the grid was extended until the planned acreage could be mapped. Within each one-acre grid, one half-acre of geophysical data was then collected, and within each half-acre grid, one quarter-acre of geophysical data was collected. This method allows collection of geophysical data within the half of each grid that has the least brush and groundcover, thereby minimizing the amount of brush cutting necessary to allow data collection. For the replacement grids located in Sector M3-1L, the grids were surveyed as half-acre grids and geophysical data was collected over the entire half-acre. The oversized grid method was not used because the replacement grids were scoped to provide the same amount of sampling as the original planned clusters by changing the distribution and location of the grids. These grids were different due to the scope change described previously in 3.5.4.4. The size of the grids on the figures within this report is the acreage geophysically investigated.

3.4.5.2.6 For half-acre grids that were laid out as 209-foot by 104.5-foot rectangles, a single USRADS setup was attempted although most grids required two separate USRADS setups due to terrain and distance issues. The half-acre grids having dimensions of 147.6 feet square were laid out in Characterization Sector M3-1L. Data was collected from these grids predominantly using a single USRADS setup. A minimum of eight USRADS stationary receivers (SRs) were utilized for each setup. Four SRs were placed on known control points that were located by a registered professional surveyor within each setup. Three of these locations were used as fixed points within the USRADS software. The fourth known control point was not fixed and was used as a quality control check on the repeatability of the overall USRADS setup between the data acquisition and the anomaly reacquisition phases.

3.5.5.2.7 EM61 data were acquired for each USRADS setup using a line spacing of approximately 2.5 feet. Geophysical data were digitally recorded at a rate of 10 readings per second, and position data at a rate of 1 reading per second. Prior to and after each data acquisition session, a metal object was traversed three times in opposite directions in order to provide information on the repeatability of the EM61 signal, as well as to evaluate the time variance inherent to the USRADS data recording process.

3.5.5.2.8 Within data collection transects (or clusters), twelve parallel 200-foot segments, separated by 25 or 50-foot spacings, defining a rectangular “zigzag” data collection pattern were established and walked (refer to Figure 3-3, located at the end of this chapter). For 103 of the clusters, digital geophysical data were collected in the field, processed, and interpreted to formulate digsheets for the intrusive investigation crew. Waypoints spaced at intervals of ~ 50-100 ft within each cluster were surveyed with high-resolution DGPS measurements to an accuracy of +/- 3.3 ft in order to provide location control for the post processing of the geophysical data, as well as for reference information during target reacquisition and excavation.

Although data were digitally recorded, processed and interpreted for these 103 clusters, intrusive investigation crews primarily used the flags placed during the acquisition effort by the field team to guide the intrusive program as described in section 6.6.3.2.4 of the Bravo work plan. The flag placement enabled crews to more quickly locate anomalies selected for reacquisition by the geophysicists. During data acquisition, the digital data from the EM61 were "paused" when an audible response occurred, and a pin flag placed at the location of the audible response. After placing the pin flag, the digital data recording process was initiated by the field team until the next audible response, where the digital recording was again "paused". This sequence was performed throughout each of the clusters.

3.5.5.2.9 The 1D delineation transect method was performed over suspected high-OE density areas in Bravo to further define the extent of these areas. Delineation Transects are basically straight segments approximately 3.5 feet wide with varying lengths. Several Delineation Transects were established in a particular area in a north-south and east-west grid-like pattern and walked for data collection. Fifty-three of these were in the original sampling plan, since five high-density/high likelihood Characterization Sectors were identified from historical records and pre-EE/CA field reconnaissance. However, sampling activities identified another potential high-likelihood OE area in the vicinity of grids 542 and 566, in the southeastern portion of M3-1L Mixed Projectile Area-PR. Thirteen delineation transects were added to the sampling plan to further define the extent of this new high likelihood area. These seventy 1D transects were performed in order to provide additional information on the spatial extent of OE materials surrounding these high density areas and were collected using an EM61 high resolution metal detector. The delineation transect data were digitally recorded and processed/interpreted by using linear interpolation between stakes (i.e., waypoints) located with high resolution, differentially corrected Global Positioning System (GPS) data. Since these data were collected for anomaly distribution information only, intrusive activities were not performed along delineation transects.

3.5.5.2.10 The linear interpolation method was used for positioning along the 1D delineation transects. The linear interpolation method was performed by starting data collection on a known point, the operator then walked in a straight line at a constant speed to a second known point. The position data was then interpolated between the points using software developed by TtEC. All transect start and end points were established by a RLS utilizing high resolution GPS accurate to within 5-cm. The start time, end time, transect start point, transect end point and file EM61 file name were all recorded in the data field log book.

3.5.5.3 Geophysical Data Processing

The following paragraphs discuss the major processing steps for the two-dimensional (2D) grids. Data acquisition over 2D grids involves transporting the geophysical sensor along closely spaced parallel transects separated by approximately 2 to 3 feet. Digital sensor and position measurements were acquired and recorded by the USRADS system .

3.5.5.3.1 USRADS position data was reviewed and processed by the site geophysicist using Chemrad software Version 1.54n. The relative accuracy of the acquisition track path was analyzed, as well as the correctness of the fixed points and the quality control point(s). Position and EM61 data were output as ASCII text files (*.dat) for the top and bottom EM coil readings.

3.5.5.3.2 Further processing was completed using Uradproc Version 3.5 (TtEC internally developed software) to check the data acquisition geometry and sample interval as well as the dynamic range of EM61 measurements. Bias was removed from the top and bottom coils, signal drift corrected (if necessary), and minor instrument positioning corrections applied to correct for the time lag of the USRADS data acquisition system. Where grids existed in close proximity or were conterminous, the data acquired over the time synchronized object was removed. The data was output as a single file (*.xyz) that includes position, signal intensity, and information on the sample interval and elapsed distance of the position measurements. A documentation sheet was completed for each grid processed.

3.5.5.3.3 Oasis Montage Version 5.03 was used to create 2D color-coded images of the EM61 data. The 2D images and xyz profile data were assessed in terms of the background variation of the measurements and the relative quality of the track path. Figure 3-3, located at the end of this chapter, presents an example of the color-coded image maps (anomaly maps).

3.5.5.3.4 The following paragraphs discuss the processing steps that were performed for the 1D data collection transects (clusters), as well as the delineation transects.

3.5.5.3.5 GPS data for the waypoint stakes were processed using Grafnav software Version 6.02. The Root Mean Squared (RMS) error of each waypoint position was analyzed. DAT61 software version 1.10 was used to assess the correctness of the fiducial marks placed in the data at waypoint markers. The background variation of the measurements was also assessed. Crwproc version 2.2 (TtEC internally developed software) was used to link the GPS position data and EM61 measurements via an interpolation process. Bias was removed from the top and bottom coils and signal drift was corrected (if necessary). This data was output as a single file (*.xyz) that included position, signal intensity, and data on the sample interval and elapsed distance of the position measurements. A documentation sheet was completed for each transect processed.

3.5.5.3.6 Due to the constraints of the extreme terrain in the mountains, no digital geophysical data was recorded on the mountain transects. Data collection consisted of manually recording audibles received from the White's detector and Schonstedt.

3.5.5.4 Geophysical Data Interpretation

Data was interpreted using two independent modes of target prediction (1D profile data and 2D color-coded image data) to provide x, y, and z location information for each target selected, as well as the target's approximate size and depth. The 1D interpretation method was used for the delineation transects and some of the cluster mode of acquisition, and the 2D interpretation method was utilized for data acquired over survey grids. For the 1D interpretation, the EM61 and coordinate data were graphically displayed on the computer screen as data profiles for review by the interpreter. The interpreter selected the anomalies using the criteria specified in the Site-Wide Work Plan. In general, these criteria include amplitude, shape, and relationship between Channel 1 and Channel 2 of the EM61 signal; repeatability (standard deviation) and shape characteristics of the data points surrounding the potential target; assessment of cultural features (e.g., roads, buildings) within or adjacent to the survey area; and other pertinent information gathered from the acquisition team on the terrain, vegetation, and geology.

USAESCH audited geophysical data from the Bravo EE/CA investigation and prepared a Quality Assurance Audit Evaluation. The report is included as Appendix E.

3.5.5.4.1 Digsheets were not generated for the delineation transects because the target locations selected were not planned for excavation. The interpreted data were used to provide additional information on the possible spatial distribution of OE materials near 2D survey grids where a high percentage of OE materials were identified during intrusive activities.

3.5.5.4.2 For the interpretation of the 2D survey grids the EM61 data was color-coded using an interpolation (gridding) process. Figure 3-4, located at the end of this chapter is an example of the printouts of the 2D color-coded EM61 data for grids. The resulting data was interpreted using amplitude, shape, and relationship between Ch1 and Ch2 of the EM61 signal; 2D geometry (morphology) of the anomaly, including lateral gradients; geometry (shape) of the USRADS data acquisition path (e.g., obstacles, line gaps.); repeatability (standard deviation) and shape characteristics of the data points surrounding the potential target; other pertinent information gathered from the acquisition team on the terrain, vegetation, and geology; and anticipated response of the most probable munitions (MPM's).

3.5.5.4.3 As a general guideline, a single target location was selected within a 3.5-ft radius of the peak intensity value of the EM61. Peak intensity values separated by more than 3.5 ft were interpreted as individual target locations, unless the morphology of the anomaly suggested that a single target was probable. This determination is intuitive and depends upon the experience of the interpreter. The target selections were classified as primary or secondary (same as A or B target classifications in transect data) based on the overall anomaly characteristics (amplitude, shape, estimated depth and size, field notes describing above ground features, and any surface clearance, historical, and excavation data from the surrounding area). The primary and secondary classification was used to assist in the sampling program for grids where only a percentage of the targets were excavated. Primary targets were those that had geophysical characteristics that were similar in nature to the OE items of interest in a particular area or for a phase of the project. Secondary targets had geophysical characteristics that were not similar in nature to the OE items of interest for a particular area. The goal was to intrusively investigate a percentage of the secondary targets to obtain a check on the overall correctness of the interpretation in terms of the classification scheme. It has been our approach that credit can be taken for sampling some quantity of area if it is both surveyed and intrusively investigated. The convention at Ft. McClellan, and at most other UXO sites, is that you can take sampling credit for the acreage surveyed in direct proportion to the fraction of primary targets or anomalies that were intrusively investigated. For example, take the case where 10 acres is surveyed within a particular area and 100 primary targets are identified. If all 100 primary targets are dug and positively identified, the sampling credit would be 10 x (100/100) = 10 acres. if, however, only 40 of the primary anomalies are dug and positively identified, the sampling credit would be 10 x (40/100) = 4 acres. Credit is directly tied to the fraction of the primary targets intrusively investigated. Dig packages with color-coded maps, target characteristics, coordinate locations, and classifications were provided to the Senior UXO Supervisor (SUXOS) for review prior to intrusive operations.

3.5.5.5 Geophysical Target Reacquisition

The target reacquisition process for the 2D grids involved positioning the USRADS SRs over the same control points used during data acquisition. Using the USRADS positioning crystal as a guide, the field crew occupied the selected target locations and interrogated the immediate area with the EM61 Hand-held (HH). A pin flag was placed at each target location and relevant data (i.e., target id, distance from interpreted location, comments) was digitally logged to a field palmtop and uploaded to the data management computer at the end of each day. No target reacquisition was required nor completed for the delineation transects. Target reacquisition for several interpreted data collection transects (clusters) in the northern portion of Bravo was completed using a tape and line method. For each interpreted anomaly the relative distance from two adjacent waypoint stakes was identified on the dig sheet. Measuring tapes were used to measure this relative distance from each waypoint and identify the anomaly location in the field.

3.5.5.5.1 No targets were reacquired in the mountain transects or supplemental transects because they were acquired real-time. These transects were flagged using audibles.

3.5.5.6 Intrusive Sampling

Intrusive sampling of selected anomalies was performed to identify and properly remove UXO from the subsurface and from a maximum depth of four feet. In the initial fieldwork, intrusive activities were performed in 46 of the 209 grids in which TtEC collected geophysical data. In addition to the 209 grids geophysically mapped, 33 grids were laid out, some of which were also surface cleared, but were not geophysically investigated due to the presence of 40mm OE or other surface OE. These grids were characterized prior to geophysical data collection. These grids are within areas of high-likelihood OE contamination and are recommended to be carried forward for removal action. Selected anomalies within the 209 grids geophysically mapped were excavated for the purpose of sector characterization, but also for the purpose of data validation of anomalies in other grids where no intrusive sampling was performed. The rationale for this data validation approach was that some portion of the geophysical anomalies were excavated to verify that a given anomaly signature is one that does or does not represent a potential OE item of interest. Anomaly signatures observed in the geophysical data were initially classified as primary or secondary. Primary anomalies were those thought to potentially represent a 37mm projectile or larger ordnance item. Based on intrusive results from anomalies with a range of signatures (both primary and secondary), the ability to identify a potential OE item through geophysical signature was verified, or validated.

3.5.5.6.1 Intrusive activities also were performed in 107 of the 145 geophysically mapped data collection transects. This represents 74 percent of the total data collection transects that contained geophysical data. Within the transects that were intrusively investigated, all flagged anomalies, located based on audible signals from the EM61, were dug. The remaining data collection transects were not intrusively investigated for one of the following reasons: 1) the transect path subsurface did not yield any audible EM anomaly signals during data collection; 2) the transect path surface contained 40mm OE and was designated off limits for further activities; or 3) the transect path intrusive activities would have created unacceptable exclusion zone impacts to roads and facilities outside the installation if intrusively investigated. An additional 41 data collection transects were laid out, some of which also were surface cleared, but were not

geophysically investigated due to the presence of 40mm OE or other surface OE. These data collection transects were characterized prior to geophysical data collection.

3.5.5.6.2 Intrusive activities were performed in each of the 24 mountain transects in the Bravo Area. One anomaly was excavated every 290 feet along the 7.5 miles of mountain transects walked. This represents 10 digs per acre of transect area covered, at a transect width of 15 feet. Digging one anomaly per 290 ft represented 10 digs per acre of transect covered. The USAESCH and TtEC believed this was sufficient characterization for this area of Bravo where it had been shown through reconnaissance, the ASR, and in other documentation of range activity that there would be a low density of UXO and ordnance with explosive hazards. The Mountain Transect investigations were conducted by three-person crews. The crews consisted of a UXO Technician III and two UXO Technicians II. One team member was responsible for the hand-held locator; while the other two team members took notes, assisted with the visual inspection, and dug identified targets. The crews walked along every segment of every mountain transect and counted the number of audible signals detected with the White's metal detector. As described in section 6.6.3.2.6 of the Bravo Area Site Specific Work Plan (April, 2001), the crews detected OE using a visual survey of the 15-foot wide swath and used the magnetometer to detect OE in the center 3 to 4 foot part of the swath. The team dug one audible anomaly in each 290 foot segment. There were no audible signals in some segments. In the event that a segment did not have an audible, the crew would increase the number of digs in the next segment. The surface findings and results of all digs are in Appendix F. The number of audible signals heard in each 290 foot mountain transect segments are also in Appendix F.

3.5.5.6.3 Following geophysical data collection and intrusive activities performed within the grids and transects of the original sampling plan, one large area within Sector M3-1L suspected of containing a high density of OE was further geophysically investigated using delineation transects. The area is located within the southeastern portion of M3-1L around grids 542 and 566. Intrusive results yielded a large amount of 155mm Shrapnel OE Scrap in grid 542 and 75mm Shrapnel OE Scrap in grid 566. Since this indicated a potential high OE density area that was previously unrecognized, geophysical data was collected along a series of delineation transects added to the sampling already performed in this area. This acreage was in addition to the required sampling acreage originally calculated for Sector M3-1L.

3.5.5.6.4 All geophysical and intrusive data collected during the initial site characterization was reviewed to determine if enough information had been collected relative to the amounts specified in the Work Plan for each sector. No ordnance was found in the M3-1L-Remainder Area OE Risk Assessment Sector, so a new calculation was performed using the Minimum Discrimination Module of the UXO Calculator to establish a tailored sampling benchmark for that sector. Again, a 90 percent level of confidence was prescribed and an OE target test density of 0.1 OE/acre was selected and applied based on the projected future land use. The amount of investigation performed during the initial site characterization was less than the benchmark quantity. It was determined that additional characterization would be necessary to more accurately distinguish the boundaries between areas of suspected OE contamination and areas with low or no contamination. TtEC performed additional intrusive investigation in 32 grids (Section 3.3.5.7 below). These grids were primarily located in the M3-1L in an area designated as a "Low Likelihood" area but with limited information. Additional sampling was conducted to further delineate the boundaries of suspected OE contamination and low areas. Additional Sampling in Selected Grids

3.5.5.7 Additional Sampling in Selected Grids

Additional meetings between TtEC, Fort McClellan Transition Force, and the Corps of Engineers, Huntsville Center highlighted the need for additional sampling in the M3-1L Area of Bravo to further and more accurately delineate the boundaries between the areas of "High Likelihood" and "Low Likelihood" of OE presence. TtEC performed additional intrusive activities in 32 Grids. This sampling was conducted as Modification 12 to the existing Task Order. These selected grids were grids that had been geophysically mapped and some anomalies intrusively investigated during the site characterization. It was decided that all primary and secondary anomalies previously identified in each of these grids would be intrusively investigated. Grids 502, 508, 509, 510, 511, 512, 513, 514, 517, 518, 519, 523, 525, 531, 544, 545, 548, 549, 550, 551, 553, 555, 556, 559, 564, 567, 569, 570, 571, and 574 were investigated from July 15 through July 25, 2002. Grids 171 and 526 were investigated from August 1 through August 5, 2002. All data collected from these grids was incorporated into the existing database for the Bravo Area.

3.5.5.8 Sampling in the Supplemental Transects

A November 18, 2003 ADEM meeting noted data gaps within the No Further Action area, and a need for further sampling of transects was noted. Supplemental sampling was conducted in Sector M3-Remainder Area-PR in July 2004. This supplemental sampling was conducted as Modification 16 to the existing Task Order. The objective of the addendum was to collect supplemental data to assist ADEM in their assessment of the risk reduction alternatives proposed for the area in question. ADEM and the Army positioned 41 supplemental transects in the mountain portions of Bravo at a meeting in February 2004. Table 3-1 indicates the logic for placement of the supplemental transects. Transects were placed near existing grids and transects with OE-related finds.

Table 3-1
Process for Placement of Supplemental Transects

Findings In EE/CA Investigation	Identified in	Transects For Further Investigation
Armor Piercing Tracer (APT) OE Scrap	Grid 549	None
APT OE Scrap	Grid 556	T51 and T60
APT OE Scrap	MT01	T30, T31, T33
Armor Piercing Capped (APC) OE Scrap	Transect M31m020	T63
APC OE Scrap	Transect M31m027	T32
APC OE Scrap	Transect M31m036	None (Grid 564 near)
APC OE Scrap	Transect M31m037	T29 and T32
APC OE Scrap	Transect M31m042	T28 (many transects nearby)
Fuzes and Fuze Pieces	Transect M31m043	T28
Fuzes and Fuze Pieces	T04 and T06	T33 and T34
Fuzes and Fuze Pieces	T21	T60, T61, and T62
Fragmentation	T10	T40, T41, and T57

3.5.5.8.1 An addendum to the Bravo Site Specific Work Plan was submitted to ADEM and approved. The Work Plan Addendum stated all anomalies up to a total of 40 within each 290-

foot segment of each supplemental transect would be dug, then every other anomaly up to a total of 100, then every third for the remainder of each segment. However, crews did not find 40 or more anomalies in any segment of any supplemental transect. Therefore, they dug every anomaly located in every supplemental transect. Forty-one supplemental transects were investigated. The supplemental transects were 5 feet wide and each segment was 290 feet long. The total investigated transect length was 12.31 miles. A Schondstedt hand-held detector was used to perform the intrusive investigation and all anomalies were investigated. The supplemental transects were numbered T25 through T65. Only OE or OE Scrap was logged in the hand-held instruments. Non-OE items were counted as items found but were not recorded. See Table 3-2 for the tally of anomalies. Four transects (T30, T31, T44, and T63) contained OE Scrap items, for a total of 6 items. Three items were found on the surface, two items were found at 2 inches, and one item was found at 3 inches.

3.5.5.9 Additional Sources of Information

In addition to the grids and transects sampled by TtEC within the Bravo Area, information from three other sources was also incorporated into this EE/CA. TtEC conducted a Field Reconnaissance of the 247Q (A3), A1, and A2 Areas. Only the A1 area is within the Bravo study area. The A2 area bounds Bravo to the south. The 247Q (A3) Area is located approximately ½ mile south of the A2 area. The A1 area is a 27-acre area located just south of the main cantonment area. This area was originally excluded from the Bravo EE/CA but was subsequently incorporated by direction of USAESCH. It was combined with a sector that was already part of the Bravo Area and the new combined area was renamed as the A1-Reconnaissance Area-Development (D). Appendix C contains the reconnaissance report and a figure showing the boundaries of the areas.

3.5.5.9.1 One UXO item identified during the Eastern Bypass Removal Project was located on the boundary separating the Eastern Bypass Right of Way and the Bravo Area. To address this item, a 200-foot buffer was extended from the location of the item into the Bravo Area. This "buffer" area has been included as part of the M3-1H-Mixed Use Area – D sector.

3.5.5.9.2 Parsons performed sampling activities for various sites at Fort McClellan as part of a RCWM EE/CA (Parsons, 2002). The RCWM EE/CA included an area known as the Old Burn Pit. The Old Burn Pit was comprised of three depressions suspected as former burn pits. These depressions were intrusively investigated during the performance of the field activities for the RCWM EE/CA. These depressions are located in the northern portion of Bravo near Grid 587. The findings by Parsons were included in the characterization of Bravo. Appendix F contains a table of the findings for the Parsons investigation. IT Corporation provided information to TtEC concerning surface OE found during their performance of HTRW fieldwork for various locations within the Bravo Area of Fort McClellan. Findings from these sources were used to supplement the data collected by TtEC. The IT findings are discussed along with other surface OE data in each sector-specific chapter.

3.6 SOURCE, NATURE, AND EXTENT OF OE

3.6.1 Investigation Results and Findings for the Characterization Sectors

The Bravo Area was initially divided into ten Characterization Sectors for the purposes of the EE/CA sampling. Based on historical records and field reconnaissance, these consisted of 5 Characterization Sectors expected to contain OE, three sectors with a medium likelihood of containing OE, and two sectors that were not expected to contain OE.

3.6.1.1 Overall, 242 grids (209 geophysically surveyed and 33 characterized based on surface finds), 186 (145 geophysically surveyed and 41 characterized based on surface finds) data collection transects, 24 mountain transects, and 70 delineation transects were investigated by TtEC from April 2001 until August 2002 (see 3.6.1.3 for discussion of the 41 supplemental mountain transects, which are not included in this summary). In the subsurface data collection, a total of 5,121 anomalies (3,833 primary and 1,288 secondary) were identified during the geophysical investigation. Of these, 1,164 anomalies (22.7 percent) in 78 grids were excavated during the intrusive investigation. Intrusive results for all of Bravo (grids and transects) revealed that 1,172 out of 1,737 anomalies, 67.5 percent of all anomalies investigated, were due to the presence of OE or OE Scrap. OE Scrap included spent projectiles, fuzes, grenades, and metal fragmentation from exploded ordnance. Non-OE Scrap was found at 519 out of 1737 anomalies, 29.8 percent of the anomalies. The remainder of anomalies investigated were either no finds or unidentifiable (NA classifications). Appendix F presents a table with a complete list of the intrusive results. The following paragraphs include a summary of the findings for the original ten Characterization Sectors from the site characterization.

3.6.1.2 Additional meetings between TtEC, Fort McClellan Transition Force, and the Corps of Engineers, Huntsville Center highlighted the need for additional sampling in the M3-1L Area of Bravo to further and more accurately delineate the boundaries between the areas of "High Likelihood" and "Low Likelihood" of OE present. TtEC performed additional intrusive activities in 32 Grids in M3-Remainder Area-PR. This sampling was conducted as an addendum to the existing task order. These selected grids were grids that had been geophysically mapped and some anomalies intrusively investigated during the site characterization. It was decided that all remaining primary and secondary anomalies previously identified in each of these grids would be intrusively investigated. Grids 502, 508, 509, 510, 511, 512, 513, 514, 517, 518, 519, 523, 525, 531, 544, 545, 548, 549, 550, 551, 553, 555, 556, 559, 564, 567, 569, 570, 571, and 574 were investigated from July15 through July 25, 2002. Grids 171 and 526 were investigated from August 1 through August 5, 2002. All data collected from these grids was incorporated into the existing data from Bravo and is included in the above number summaries.

3.6.1.3 The November 18, 2003 ADEM meeting noted data gaps within the No Further Action area, and it was determined that further sampling should be conducted in additional mountain transects. Sampling of 41 supplemental Mountain Transects was performed in July 2004. The work plan addendum stated that all anomalies up to a total of 40 within each 290-foot segment of each supplemental transect would be dug, then every other anomaly beyond that up to a total of 100, then every third for the remainder of each segment. However, field crews did not find 40 or more anomalies in any segment of any supplemental transect; as such every anomaly located in every supplemental transect was dug. Table 3-2 lists the supplemental transects, the number of anomalies (equal to the number of digs) in each transect, and the number of OE Scrap items

found. Crews dug 212 items in the 41 supplemental transects, found 6 OE Scrap items (all 37mm TPT), and 206 Non-OE Scrap items. No OE or UXO was found. According to the agreement with ADEM, OE and OE Scrap were to be logged while non-OE items were counted as items found but were not recorded. The data regarding the OE Scrap found is not included in the numbers presented in section 3.6.1.1 but was included in the Table of Findings at Appendix F.

3.6.1.4 Thirty-three grids and 41 data collection transects were characterized based on surface OE found in or adjacent to these investigation areas.The grids are numbered 001, 002, 007, 008, 009, 010, 024, 098, 099, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 136, 142, 143, 144, 145, 146, 147, 149, 151, 152, 153, 155, 168, and 169. These grids are located in Sectors M3-3H Rocket/Hand Grenade Area-D, M3-2M Hand Grenade Area PR, M4-1H Mixed Use Area-PR. Surface clearance activities in these 33 grids resulted in the discovery of 75 significant UXO and OE Scrap items. Sixty-three UXO & OE Scrap items were identified in the characterized data collection transects. These items are included in the numbers presented in section 3.6.1.1. In M3-3H Rocket and Hand Grenade Area-D and M3-2M Hand Grenade Area –PR, geophysical and intrusive activities were stopped due to the presence of 40mm items identified. The Grids where the presence of 40mm items was likely are color-coded pink on Figure B-2 in Appendix B. The remaining Characterized grids are color-coded based on the target type. In Sector M3-1L Rocket Area – D, where intrusive activities could not be performed due to their close proximity to the Fort McClellan Boundary and the requirement to close down a highway and evacuate the public, 19 data collection transects were characterized based on surface finds by TtEC and IT Corporation.

3.6.1.5 Parsons intrusively investigated an area known as the Old Burn Pit that is located along the northern border of the Bravo Area just south and east of grid 587. The Old Burn Pit site was identified for consideration during the field visit for the ASR. The site was selected for further sampling to ensure that RCWM was not present. Three depressions near the Old Burn Pit were intrusively investigated. Burn Pit 1 contained multiple inert and practice OE items and other metal debris. Findings included 23 practice rifle grenade bodies, two practice 60mm mortars with fins, an 81mm mortar with no fuze or primer, two rifle grenade tail booms, and multiple .30 caliber casings and clips. Burn Pit 2 contained a steel box with cans, wire-wrapped cans, plate glass, and one MK2 practice grenade. Burn Pit 3 contained flakes of rust and jar lids (Parsons, 2001). These items are listed in a table of findings for the Parsons investigation in Appendix F but are not included in the Table of All Findings and are not included in the totals in section 3.6.1.1.

3.6.1.6 During a separate environmental investigation, IT Corporation found 34 OE/UXO and OE-related items on the surface while performing OE avoidance during HTRW investigations in sectors M3-1L, M3-1M, M3-1H, M3-2H, and M4-1M. Findings in M3-1L included twelve 2.36-inch rockets, five 60mm mortars, one 3-inch stokes mortar, an unidentified ordnance item (possibly a grenade), one 3-inch rocket motor, and an 105mm projectile. In M3-1M, two 2.36-inch rockets, one 37mm projectile, and four 60mm mortars were located. In M3-1H, only one 2.36-inch rocket was found by IT. Findings in M3-2H included two 60mm mortars and two 2.36-inch rockets. In M4-1M, shrapnel from a 75-mm shrapnel round was located. The IT findings have been incorporated into the Bravo OE database and are discussed along with other surface OE data in each sector-specific chapter. These findings were not included in the summary at section 3.4.1.1.

Table 3-2
Anomalies (Digs) in Supplemental Transects

Transect	Date	No. of Anomalies (Digs)	No. of OE Scrap Items		Transect	Date	No. of Anomalies (Digs)	No. of OE Scrap Items
T25	7/7/2004	0	-		T48	7/13/2004	10	-
T26	7/7/2004	0	-		T49	7/13/2004	15	-
T27	7/27/2004	1	-		T49	7/12/2004	0	-
T28	7/26/2004	1	-		T50	7/15/2004	25	-
T29	7/26/2004	2	-		T51	7/15/2004	20	-
T30	7/7/2004	2	1		T52	7/14/2004	2	-
T31	7/6/2004	1	2		T53	7/27/2004	0	-
T31	7/7/2004	5	1		T54	7/14/2004	1	-
T32	7/19/2004	0	-		T55	7/20/2004	0	-
T33	7/12/2004	0	-		T56	7/14/2004	1	-
T34	7/12/2004	0	-		T57	7/14/2004	2	-
T35	7/28/2004	2	-		T57	7/13/2004	0	-
T36	7/22/2004	9	-		T58	7/13/2004	10	-
T37	7/26/2004	0	-		T59	7/20/2004	18	-
T38	7/21/2004	1	-		T59	7/19/2004	10	-
T39	7/21/2004	3	-		T60	7/22/2004	11	-
T40	7/13/2004	0	-		T60	7/21/2004	8	-
T41	7/13/2004	0	-		T61	7/21/2004	12	-
T42	7/15/2004	0	-		T61	7/20/2004	8	-
T43	7/28/2004	0	-		T62	7/19/2004	15	-
T44	7/14/2004	0	1		T63	7/7/2004	1	1
T45	7/15/2004	0	-		T64	7/7/2004	0	-
T46	7/12/2004	8	-		T65	7/7/2004	1	-
T47	7/12/2004	7	-					
Total Digs = 212								

3.6.2 Identification of OE Items

Items found within the sectors could be identified as OE, UXO, OE Scrap, or Non-OE Scrap. Qualified UXO Technicians classified items, recovered during the field investigations, as one of these categories. OE is defined as ammunition, ammunition components, chemical or biological warfare materiel or explosives that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried, or fired. Such ammunition, ammunition components, and explosives are no longer under accountable control of any Department of Defense (DoD) organization or activity (Headquarters, Department of the Army Policy Memorandum "Explosives Safety Policy for Real Property Containing Conventional OE"). UXO is defined as military munitions that have been primed, fused, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remained unexploded either by malfunction, design, or any other cause. OE Scrap is defined as parts of previous OE or OE related items that functioned as designed, but do not contain an explosive hazard or that could not be positively identified. Non-OE Scrap is metal that is not OE-related. An example of an

OE item is a 2.36 Rocket HE version found unfired laying on the ground. An example of a UXO item is a 2.36 Rocket HE found fired, laying on the ground. An example of an OE Scrap item is a whole or parts of a 2.36 Rocket practice, fuze fired. An example of a Non-OE Scrap item is scrap metal like a nail or pipe. If an item could not be positively identified as an HE or practice type munition, the item was vented in accordance with the applicable Work Plan, after venting it was re-inspected and then classified as OE, UXO, or OE Scrap based on its original condition. Therefore, if an item contained explosives and functioned when vented, it was classified as OE or UXO (depending on whether or not it was fired). If the item was inert, it was classified as OE Scrap.

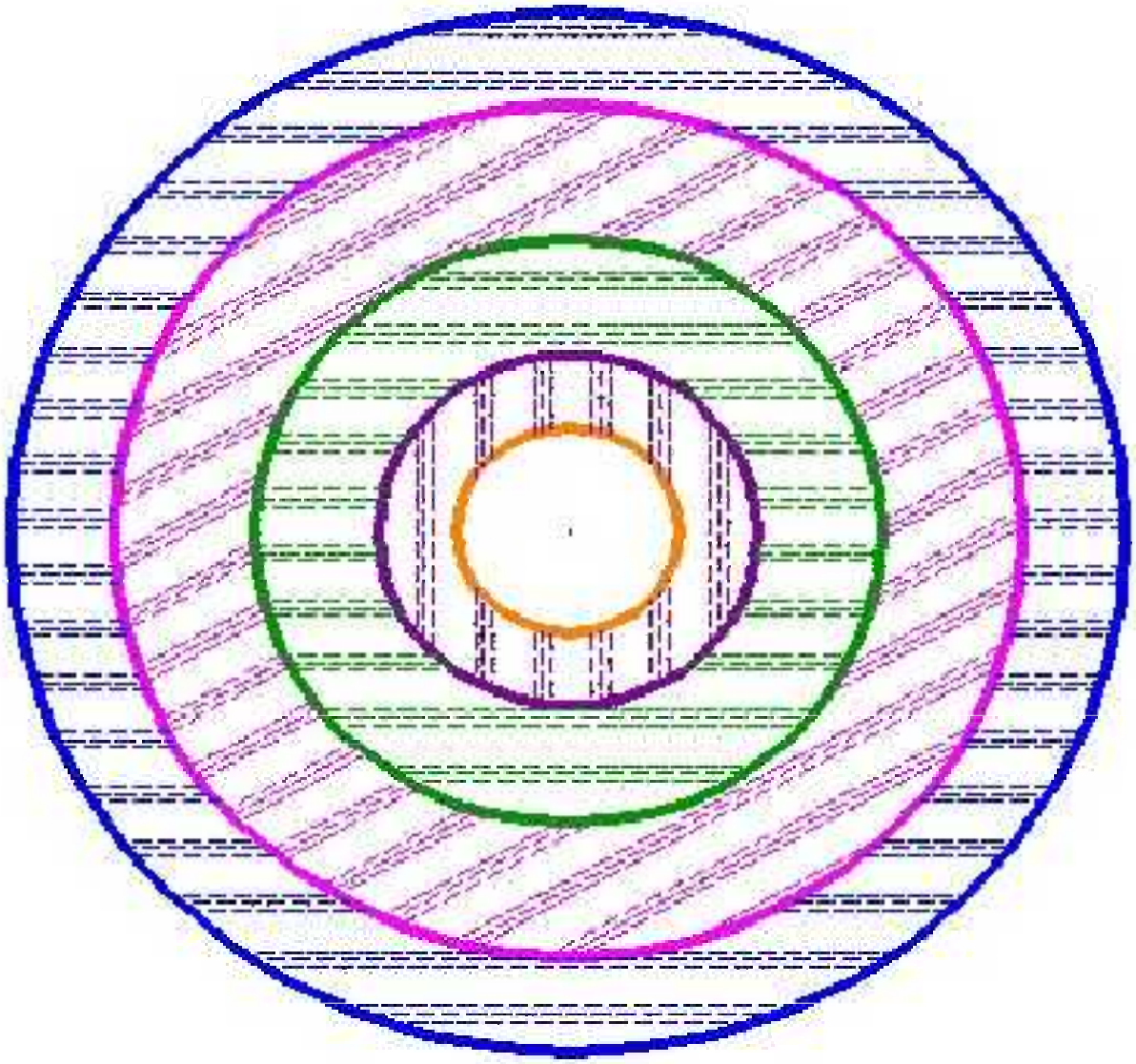
3.6.3 Areas of OE Contamination

The next step in the EE/CA process was to review the results from the site characterization and perform a risk assessment for the Bravo Area. Considering the original evaluation and Characterization Sectors of the Bravo Area, the results of the site characterization and the projected land use, the Characterization Sectors were further divided into OE Risk Assessment Sector areas for the risk assessment. The Bravo Area EE/CA Overview Figure B-2 in Appendix B presents the OE Risk Assessment Sectors defined for Bravo. The sectors were named using a combination of their original Characterization Sector name (e.g., M3-1H), the typical type of ordnance activity associated with the area (e.g., Projectile Area), and the projected land use. The objective of the site characterization is to refine and adjust the boundaries between high likelihood areas and low likelihood areas. Because of this, some of the Characterization Sectors were combined into adjacent sectors while other sectors were divided between surrounding sectors. Since some of these areas included more than one projected land use, a designator of either PR (Passive Recreation) or D (Development) was added to the end of the OE Risk Assessment Sector name. All land uses other than Passive Recreation were considered as Development. The M3-Remainder Area-PR was named using a similar naming convention. A detailed description of the risk assessment process is discussed in Chapter 4.0. Response alternatives were then recommended based on field and historical data, risk assessment results, and other pertinent criteria described in later chapters of this EE/CA. Chapters 8.0 through 24.0 address the following OE Risk Assessment Sectors:

A1-Reconnaissance Area-D	M3-1L-Rocket Area-D
M3-1H-Grenade Area-D	M3-1L-Suspect Area 1-PR
M3-1H-Grenade Area-PR	M3-1L-Suspect Area 2-PR
M3-1H-Mixed Use Area-D	M3-1H-Rocket Area-D
M3-2H-Mortar Area-D	M3-2H-Mortar Area-PR
M3-1H-Rocket Area-PR	M3-2M-Hand Grenade Area-PR
M3-1L-37mm Projectile Area-D	M3-3H-Rocket/Hand Grenade Area-D
M3-1L-Mixed Projectile Area-PR	M4-1H-Mixed Use Area-PR
M3-Remainder Area-PR	

THIS PAGE INTENTIONALLY LEFT BLANK.

Figure 3-1
Fragmentation Zone for an 81mm



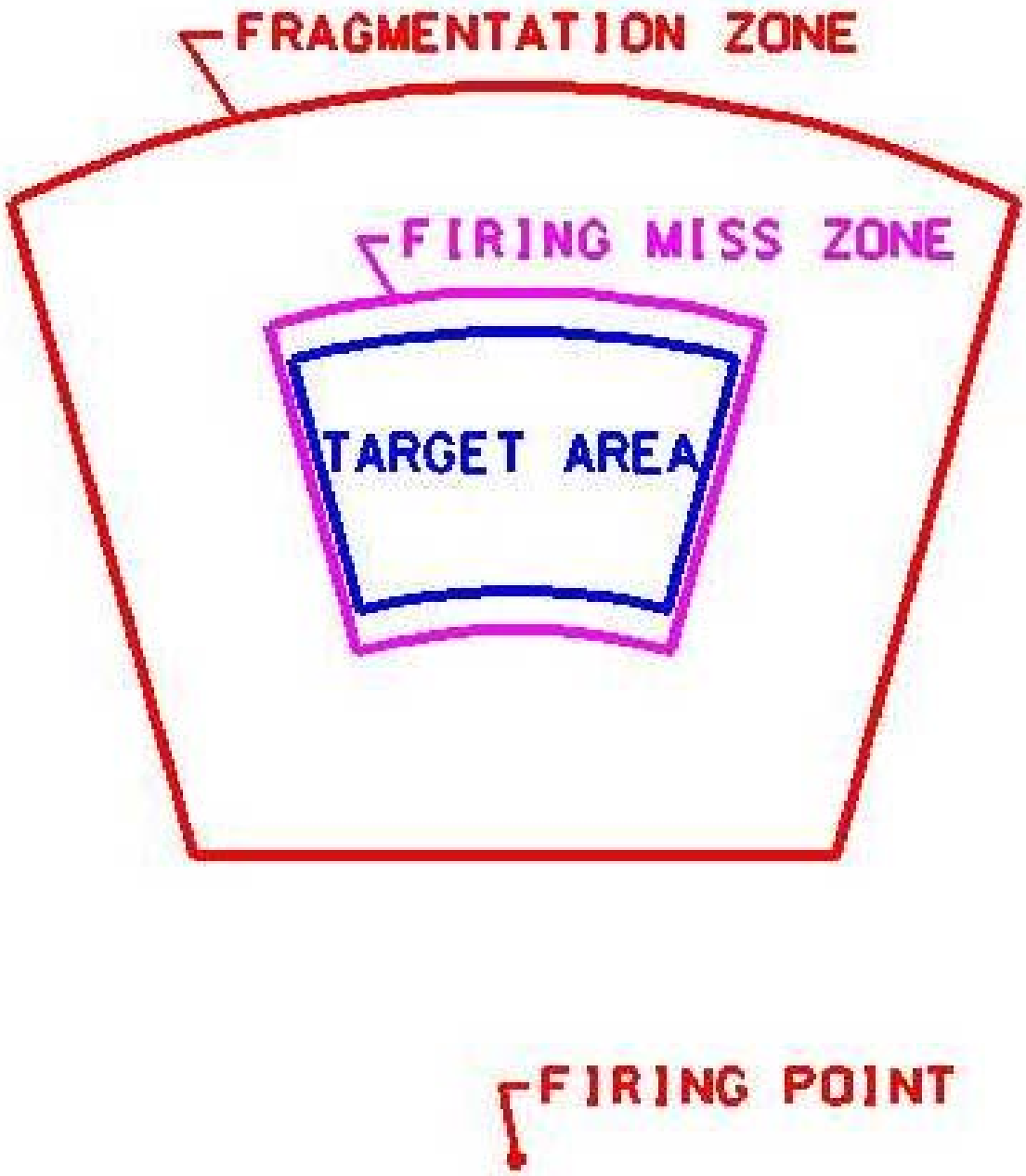
FRAGMENT DISTRIBUTION FROM DETONATION
OF A SINGLE 81mm M43 MORTAR

AREA	DISTANCE FROM DETONATION	NO. OF FRAGMENTS	FRAGMENTS/ACRE
	218 FT	531	155
	371 FT	531	82
	616 FT	1168	67
	895 FT	850	28
	1097 FT	106	1.3

SOURCE: PREPARED AND PROVIDED BY US ARMY ENGINEERING & SUPPORT CENTER, HUNTSVILLE

THIS PAGE INTENTIONALLY LEFT BLANK.

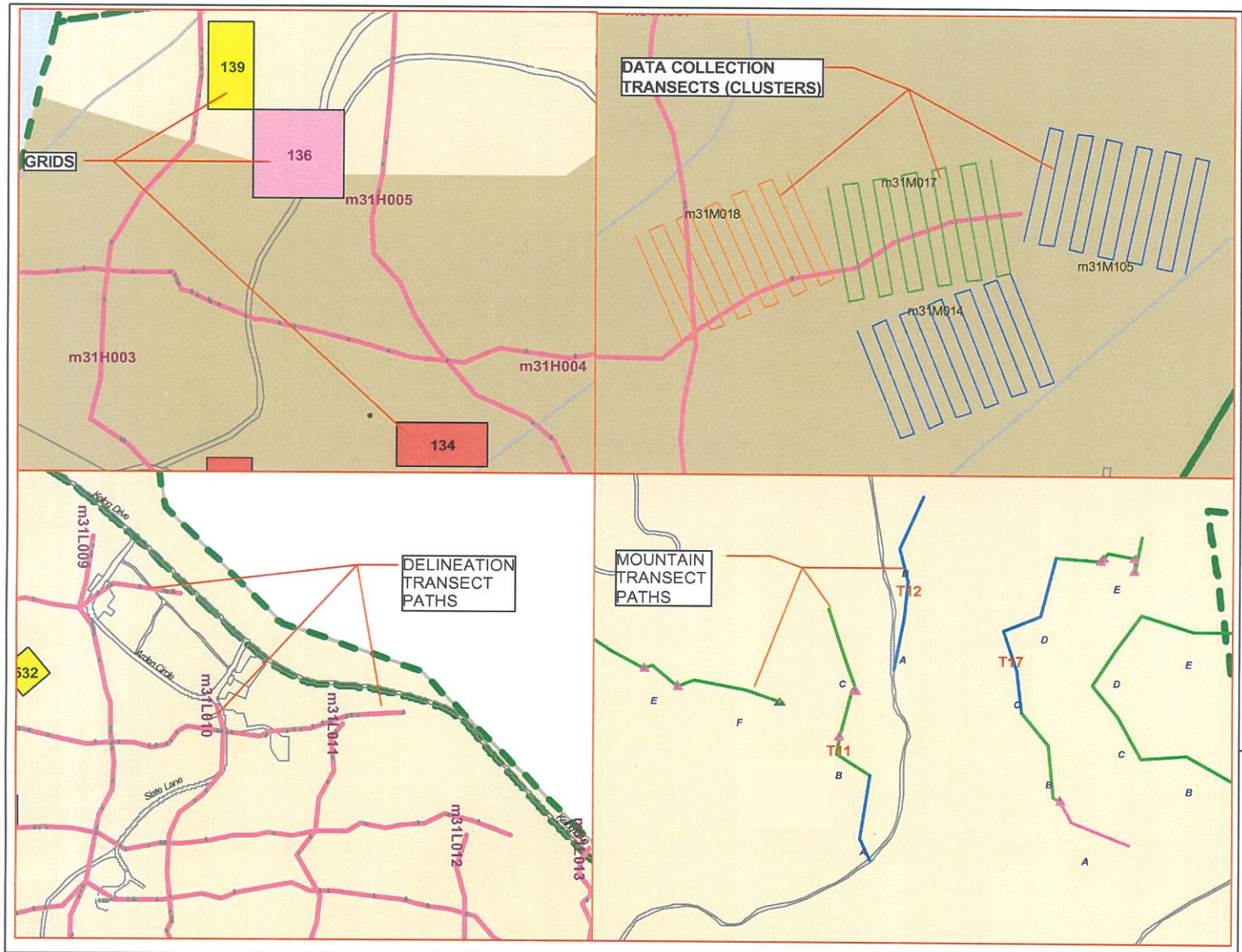
Figure 3-2
Conceptual Impact Area for an 81mm



IMPACT AREA FOR 81mm M43
CHARGES 1 & 2
MAXIMUM FRAGMENTATION RANGE = 1097 FT

SOURCE: PREPARED AND PROVIDED BY US ARMY ENGINEERING & SUPPORT CENTER, HUNTSVILLE

THIS PAGE INTENTIONALLY LEFT BLANK.



TETRA TECH EC, INC.

Figure 3-3

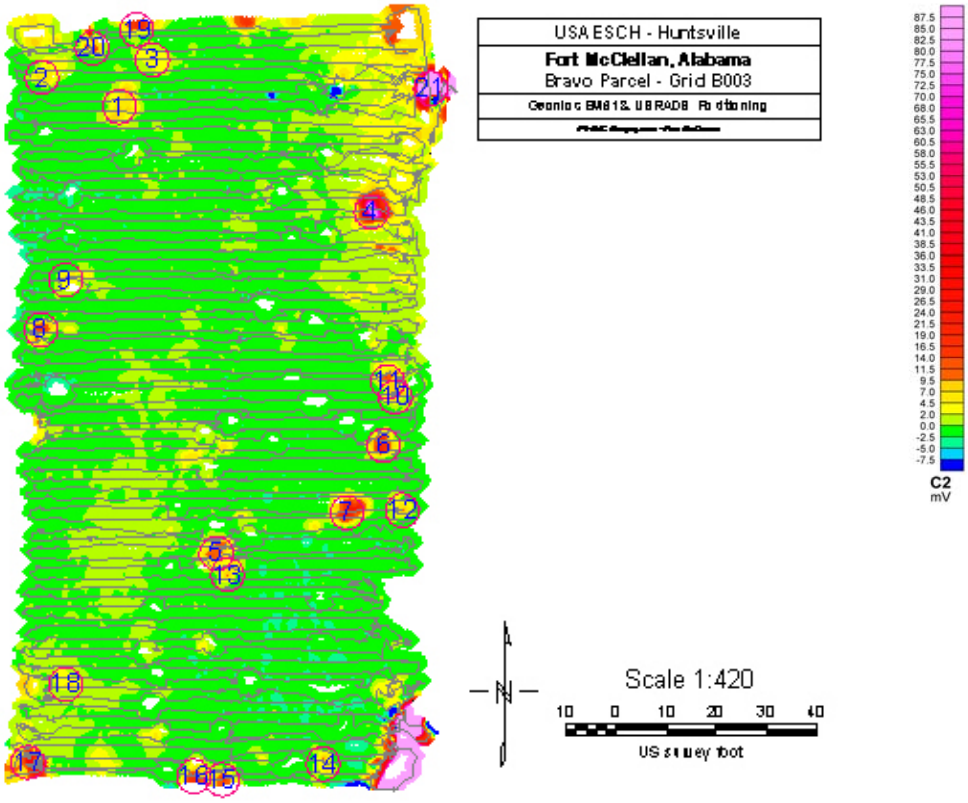
BRAVO AREA Sampling Procedures and Figure Symbology

Fort McClellan
Calhoun County
Alabama

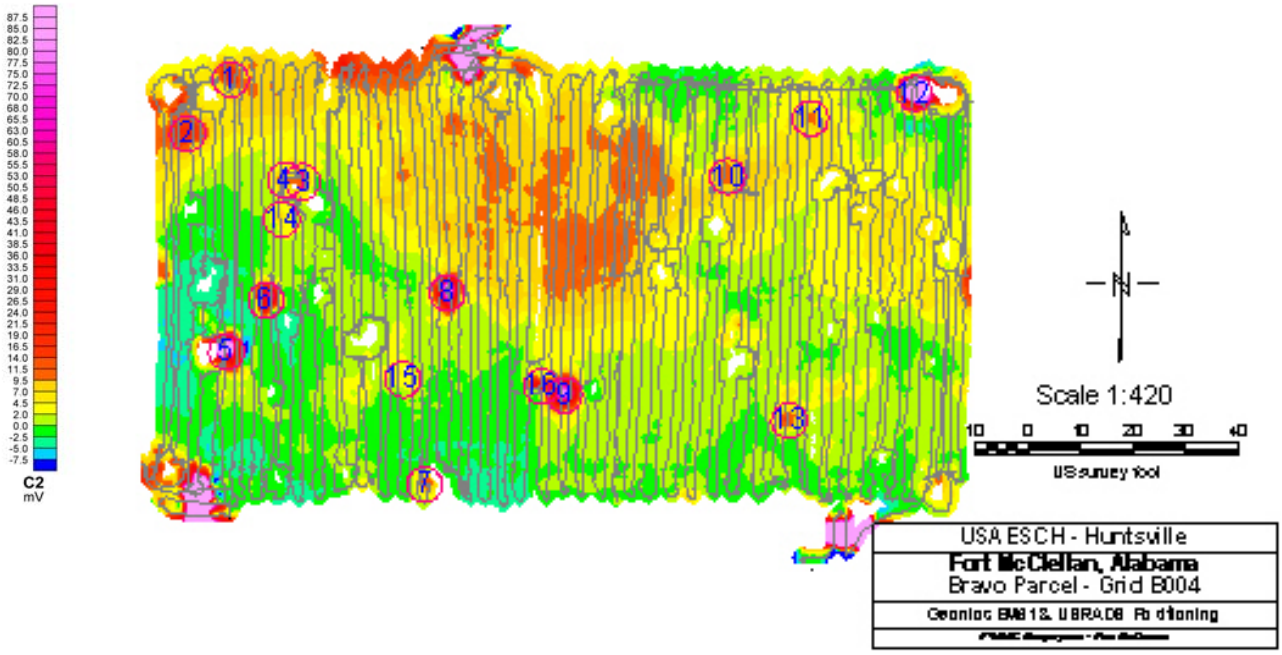
October 2004

1 **THIS PAGE INTENTIONALLY LEFT BLANK.**

Figure 3-4 Example of a Geophysical Grid Map



Bravo Parcel Grid B003



Bravo Parcel Grid B004

THIS PAGE INTENTIONALLY LEFT BLANK.

4.0 ORDNANCE AND EXPLOSIVES RISK AND PROTECTIVENESS ASSESSMENT

4.1 INTRODUCTION

This chapter describes the process used to analyze potential exposures and hazards associated with OE performed for the Bravo Area at Fort McClellan, Alabama. This baseline OE risk assessment and the subsequent assessment of the level of protectiveness and risk reduction afforded by candidate response action alternatives were undertaken as part of the EE/CA performed for the Bravo Area. This analysis was conducted using the Interim Guidance for the Ordnance and Explosives Risk Impact Assessment (OERIA) methodology (USACE, 2001). This chapter presents:

- Results of record reviews with respect to past ordnance and munitions activities performed in the Bravo Area of Fort McClellan.
- A general description of the CSMs developed for potential OE exposure for the areas being addressed under this EE/CA [NOTE: The sector-specific CSMs are presented relative to the discussions of each individual sector presented in Chapters 8.0 through 24.0 of this document].
- A brief summary of the geophysical survey and intrusive investigation work performed in these areas as part of the EE/CA and previously in certain adjacent areas.
- A general description of the OERIA risk assessment model and the site-specific modifications made to tailor the default model to Fort McClellan.
- A general description of the baseline risk assessments and a series of comparative OE risk reduction evaluations relative to candidate response action alternatives conducted for the EE/CA [NOTE: The sector-specific baseline OERIA risk assessments, the comparative analyses of the level of protectiveness associated with the various response action alternatives being considered, and the qualitative ranking of these candidate response action alternatives according to their likely impact on reducing the potential for exposure and harm due to OE are presented as part of the discussion of each individual sector in Chapters 8.0 through 24.0 of this document].

4.2 DESCRIPTION OF THE CHARACTERIZATION AREAS

4.2.1 Locations of the Characterization Areas

The Bravo Area is irregularly shaped and located in the southern portion of the Fort McClellan Redevelopment Area (refer to Figure 2-1 located at the end of Chapter 2.0). Bravo Area lies south and east of the Main Post, and west of the Choccolocco Mountains. Based on the review of the historical records for this portion of Fort McClellan and the documented field reconnaissance data, the Bravo Area was divided into ten sectors for purposes of the Site Characterization:

- Sector M3-1L (in Redevelopment Parcel M3) - Located to the east of the Choccolocco Mountains and north of the Skeleton Mountains. This is the largest and southernmost sector of the Bravo Area Characterization Sectors.
- Sector M3-1M (in Redevelopment Parcel M3) - Located west of Perry Hill, running north-to-south through the Bypass Corridor. This Characterization Sector also encompasses Sunset Hill and Yahoo Lake to the east.
- Sector M3-2M (in Redevelopment Parcel M3) - Located east of Sunset Hill and south of the Main Post. (NOTE: Sector M3-3H lies wholly within this Characterization Sector.)
- Sector M3-1H (in Redevelopment Parcel M3) - This Characterization Sector is near the Bypass Corridor, west of Sunset Hill, and south of the M1.01 Parcel.
- Sector M3-2H (in Redevelopment Parcel M3) - Located northwest of Yahoo Lake along the Bypass Corridor near Iron Mountain.
- Sector M3-3H (in Redevelopment Parcel M3) - Located to the southeast of Sunset Hill and south of the Main Post. (NOTE: This Characterization Sector is located within the outer boundaries of characterization Sector M3-2M.)
- Sector M4-1L (in Redevelopment Parcel M4) - This Characterization Sector runs northeast-to-southwest along the southeast border of the Main Post.
- Sector M4-1M (in Redevelopment Parcel M4) - Located to the west of the Choccolocco Mountains and the southeast portion of the Main Post. (NOTE: characterization Sectors M4-1H and M4-2H lie wholly within this Characterization Sector.)
- Sector M4-1H (in Redevelopment Parcel M4) - Bordered by the Choccolocco Mountains to the East and the southeast portion of the Main Post. (NOTE: This Characterization Sector is located within the outer boundary of characterization Sector M4-1M.)
- Sector M4-2H (in Redevelopment Parcel M4) - Located southeast of the Main Post and west of the Choccolocco Mountains. (NOTE: This Characterization Sector is located within the outer boundary of characterization Sector M4-1M.)

4.2.1.1 Additional investigation and characterization activities were conducted previously by TtEC under separate task orders, or by others within the boundaries of the current EE/CA. The information gained through the investigation efforts in these prior assessment areas were also considered in the performance of the EE/CA. These include:

- Eastern Bypass Corridor - The Eastern Bypass Corridor is the location of the planned new roadway through Fort McClellan. The Eastern Bypass Corridor runs roughly north-south in the western portion of Bravo Area, with a westward branching element at the northern end where an access ramp is planned. The Eastern Bypass Corridor passes through characterization Sectors M3-1H, M3-2H and M3-1M. The area within the Eastern Bypass Corridor has been surveyed and cleared of detectable OE by Foster Wheeler Environmental.
- Former A -1- Located southeast of the main cantonment area adjacent to Town Center Drive and Cassell Way. The Former A-1 Area is characterized by relatively flat to slightly rolling terrain. Field reconnaissance work was performed in this area by Foster Wheeler Environmental, by walking in transects with a magnetometer. Surface observations were

made and the number of subsurface anomalies detected as audible signals was recorded. Historical evidence indicates that this area may have been used as an anti-tank range.

- UXO Avoidance/Escort Activity - OE items have been found and recorded by IT Corporation personnel providing UXO avoidance and escort support as part of ongoing investigations in areas with possible hazardous/toxic waste contamination within the boundaries of Bravo Area. These items were all surface finds, and were located in three principal areas: (1) the southwestern portion of Bravo Area in characterization Sectors M3-2H, M3-1L and M3-1M; (2) the area extending south off the end of Rucker Street in characterization Sector M3-1L; and (3) a portion of characterization Sector M4-1M.
- Old Burn Pit - The Old Burn Pit is a wooded area behind the motor pool area on 13th Avenue. It is across the dirt road just west of the northeast corner of the D&I Area. Historic photographs have indicated this area possibly contains OE contamination. Parsons Engineering Science, Inc intrusively investigated three particular depression or pit areas. No OE items were found, but OE Scrap was found during these investigations.

4.2.1.2 The data and information collected in relation to the nature and extent of OE contamination in Bravo Area was incorporated into the assessment of potential OE exposures and risks performed for this EE/CA.

4.2.2 Projected Future Land Use and the Specification of OE Risk Assessment Sectors

All of the land within the original ten Bravo Area Characterization Sectors is within the designated Redevelopment Area at Fort McClellan. A refinement of the projected future land use for the Bravo Area (EDAW, 1997) is presented graphically in Figure 4–1, located at the end of this chapter. Based on this projection of future land use, the Bravo Area includes eight different land use designations (Note: “D” signifies a Development-related land use while “PR” signifies Passive Recreation):

- Retail (D);
- Mixed Business Use (D);
- Development Reserve (D);
- Cultural (D);
- Eastern Bypass Corridor (D)
- Active Recreation (D); and
- Passive Recreation (PR).

4.2.2.1 In addition, the area in a portion of Characterization Sector M3-1L has subsequently been considered for possible residential reuse (denoted with an “R”). This possibility also was evaluated as part of this EE/CA for this particular area.

4.2.2.1 The Retail, Mixed Business Use, Development Reserve, and Cultural land uses are projected to involve routine interaction with the surface and near-surface soils (0-6 inches or below ground surface) by the employees or patrons of the future facilities. The construction and maintenance of the facilities or structures required for these land uses, and any underground utilities associated with them, are assumed to require deeper intrusion into the soil, potentially to

several feet in the areas where construction or excavation activity would be performed. These future land uses are all designated with a "D" for development (see above).

4.2.2.2 The Eastern Bypass Corridor is associated with the new planned highway construction. This future land use is also designated with a "D". The area of the Eastern Bypass Corridor was not included in the Bravo Area EE/CA (a small piece of one sector that was part of the Bravo EE/CA is now part of the Eastern Bypass). Information collected during the removal action in a small portion at the south boundary was used for the assessment of the M3-Remainder Area-PR.

4.2.2.3 The Active Recreation land use is associated with activities performed with off-road motorized vehicles or any activity that requires amplified sound, artificial lighting, or prepared grounds or courses for activities such as golf, tennis, swimming, or team sports. Consistent with this land use is the occasional interaction of individuals with the surface and very near-surface soils. The construction of new recreational facilities and structures (e.g., involving the re-grading of the land, cut-and-fill operations, and the installation of posts and fencing) or underground utilities is also assumed to be associated with this land use. This future land use is also designated with a "D".

4.2.2.4 The Passive Recreation land use is associated with hiking, walking, biking, picnicking, horseback riding, and other non-motorized activities. Consistent with this use is the occasional incidental interaction of the individuals engaged in Passive Recreation with the surface and very near-surface soils (0-6 inches below ground surface). No significant construction of new recreational facilities and structures or underground utilities is assumed to be reasonably associated with this land use. This future land use is designated with a "PR".

4.2.2.5 Given these definitions, there is a great deal of similarity in the manner in which the surface, near-surface and deeper soils are likely to be disturbed under the future development land uses designated with a "D". Due to this similarity, and the more significant common difference in this regard relative to the soil intrusion projected for the Passive Recreation activities, the Retail, Mixed Business Use, Development Reserve, Cultural, Eastern Bypass Corridor (included portion), and Active Recreation land uses were considered to have effectively the same potential for contact with OE. Consequently, areas found to have similar OE characteristics and historic ordnance-related use and are projected for any of these future development (D) land uses were assessed together for purposes of this risk assessment. It is acknowledged that some locations within an overall Active Recreation land use area may ultimately be disturbed less intensely or less routinely than land associated with one of the other development land uses. However, the specific locations within an identified Active Recreation area where the degree of interaction with the ground may be less intensive than the other development activities are not currently known due to a lack of specific redevelopment plans. As such, all Active Recreation land use areas within Bravo Area were treated as potentially involving ground intrusive activity that could be as frequent and as deep as would be expected at other development sites.

4.2.2.6 Based on this evaluation, the Characterization Sectors and prior assessment areas were further broken out by projected future land use for purposes of the risk assessment and subsequent evaluation of the candidate response alternatives. Table 4-1 lists the OE Risk Assessment Sectors developed for each of the different Characterization Sector and land use combinations.

Table 4-1
Ordnance and Explosives Risk Assessment Sectors

Characterization Sector	Projected Future Land Use	OE Risk Assessment Sector
M3-1H	Eastern Bypass (D)	M3-1H-Grenade Area-D
	Active Recreation (D)	
	Retail (D)	
	Passive Recreation (PR)	M3-1H-Grenade Area-PR
	Developmental Reserve (D)	M3-1H-Mixed Use Area-D
	Retail (D)	M3-1H-Rocket Area-D
M3-1L	Developmental Reserve (D)	M3-1L-37mm Projectile Area-D
	Passive Recreation (PR)	M3-1L-Mixed Projectile Area-PR
	Passive Recreation (PR)	M3-Remainder Area-PR
	Culture (D)	M3-1L-Rocket Area-D
	Passive Recreation (PR)	M3-1L-Suspect Area 1-PR
	Passive Recreation (PR)	M3-1L-Suspect Area 2-PR
	Passive Recreation (PR)	M3-1H-Grenade Area-PR
	Mixed Business Use (D)	A-1 – Reconnaissance Area-D
M3-1M	Passive Recreation (PR)	M3-Remainder Area-PR
M3-2H	Cultural (D)	M3-2H-Mortar Area-D
	Passive Recreation (PR)	M3-2H-Mortar Area-PR
	Passive Recreation (PR)	M3-1H-Rocket Area-PR
	Eastern Bypass (D)	
M3-2M	Passive Recreation (PR)	M3-2M-Hand Grenade Area-PR
	Mixed Business Use (D)	A-1-Reconnaissance Area-D
	Development Reserve (D)	M3-3H-Rocket and Hand Grenade Area-D
M3-3H	Development Reserve (D)	M3-3H-Rocket and Hand Grenade Area-D
	Passive Recreation (PR)	M3-2M-Hand Grenade Area-PR
M4-1H	Passive Recreation (PR)	M4-1H-Mixed Use Area-PR
M4-1L	Passive Recreation (PR)	
M4-1M	Passive Recreation (PR)	
M4-2H	Passive Recreation (PR)	
M4-2H	Mixed Business Use (D)	A-1 – Reconnaissance Area-D

4.2.3 Conceptual Site Models for the EE/CA Characterization and Assessment Areas

The available characterization information for each of these areas was reviewed and evaluated. Based on this information, a conceptual picture of the possible sources of OE items was developed for each of the OE Risk Assessment Sectors, as well as the potential for direct contact exposure to those items assuming future reuse or redevelopment activities. This background and perspective was applied directly during the preparation of the Work Plan for the Site Characterization of the Bravo Characterization Sectors. This understanding, formulated as a conceptual model of potential exposure to OE, is summarized below for each EE/CA OE Risk Assessment Sector in the form of a CSM. A CSM depicts the potential exposure pathways associated with direct contact with energetic OE items on the ground surface and in the subsurface soils of an area. The CSM identifies the primary sources or ordnance-related activities that were, or may have been, conducted at some point in time that resulted in OE being present in an area. A CSM also identifies the principal mechanisms by which ordnance items may migrate from one location to another in the area or shift from one depth in the soil to

another. The original deposition of the ordnance items and the localized transport and migration processes results in a new distribution of OE items in the soil or other environmental media. These may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with redevelopment or reuse of the area. Within the Bravo Area, future receptors may generally include commercial or industrial workers, construction workers, and recreational users of the area. Terrestrial and (at times) aquatic wildlife may also be exposed to ordnance items present in the Bravo Area OE Risk Assessment Sectors. The CSMs for each of the OE Risk Assessment Sectors (i.e., A-1 Reconnaissance Area-D, M3-1H-Grenade Area-D, M3-1H-Grenade Area-PR, M3-1H-Mixed Use Area-D, M3-1H-Rocket Area-D, M3-1H-Rocket Area-PR, M3-1L-37mm Projectile Area-D, M3-1L-Mixed Projectile Area-PR, M3-Remainder Area-PR, M3-1L-Rocket Area-D, M3-1L-Suspect Area 1-PR, M3-1L-Suspect Area 2-PR, M3-2H-Mortar Area-D, M3-2H-Mortar Area-PR,. M3-2M-Hand Grenade Area-PR, M3-3H-Rocket and Hand Grenade Area-D, and M4-1H-Mixed Use Area-PR) are presented in Chapters 8.0 through 24.0, respectively, along with highlighted discussions of the findings of the site characterization investigation relative to the elements of the CSM.

4.3 SOURCES OF INFORMATION USED IN THE RISK ASSESSMENT

This analysis of potential OE exposure and protectiveness incorporated information and findings from several key information sources. These sources included, but were not limited to, the review of:

- Historical records for Fort McClellan and the ASR (updated 2001).
- Information gathered from the field reconnaissance conducted by TtEC in July of 2004.
- Information gathered from the field reconnaissance conducted in March and April of 2000, as documented in the "Reconnaissance Findings Report" (Foster Wheeler, August 2000).
- Results of the TtEC Corporation site characterization performed in grids and transects over the period from April 2001 to August 2002 as part of this EE/CA.
- Information gathered during the survey and clearance work performed by Explosive Ordnance Disposal Team (EODT) (October 1999) and TtEC Corporation in the Eastern Bypass Corridor (October 1999-Present).
- Information gathered by IT Corporation personnel providing UXO avoidance or escort support as part of ongoing investigations of areas of possible hazardous/toxic waste contamination within the boundaries of Bravo Area (throughout 2002).
- Information gathered during the field reconnaissance performed in the A-1 Reconnaissance Area by TtEC Corporation and reported in "Field reconnaissance of the 247Q, A1, A2, and A3 Areas" [Foster Wheeler, 2001].
- Information gathered in the Old Burn Pit Area by Parsons (February 1999).
- Fort McClellan Comprehensive Reuse Plan, November 1997, and Updated Reuse Map, March 2000 (prepared by EDAW for the Fort McClellan Reuse and Development Authority).
- Discussions with USACE and site contractor personnel.

4.4 SUMMARY OF THE GEOPHYSICAL SURVEY AND INTRUSIVE INVESTIGATION WORK IN BRAVO AREA

The complete description of the site characterization work performed in each Bravo Area Characterization Sector or OE Risk Assessment Sector is presented in Chapter 3.0 of this EE/CA Report. Table 4-2 presents a summary of the areas in each OE Risk Assessment Sector that have been geophysically surveyed (by EM61) and intrusively investigated. This table reflects the site characterization effort by TtEC in support of this EE/CA, and the results of the reconnaissance work performed in the Former A-1 Area; intrusive investigations performed in the Old Burn Pit Area by Parsons; and reported OE finds by IT Corporation while providing UXO avoidance or escort support to the chemical contamination characterization activities. The results of these investigations (in terms of the nature and amount of OE items found, their locations, and their depth in the ground) were used as inputs to the OE exposure and protectiveness assessment.

Table 4-2
Area Geophysically Surveyed and Intrusively Investigated in Each OE Risk Assessment Sector

OE Risk Assessment Sector	Total Sector Area	Area Geophysically Surveyed		Area Intrusively Investigated [1]	
		As Grids	As Transects [2]	As Grids	As Transects [2]
	(Acres)	(Acres)	(Acres)	(Acres)	(Acres)
A1-Reconnaissance Area-D	160	7.76	27.4	1.74	0.0
M3-1H-Grenade Area-D	31	0.0	1.98	0.0	1.34
M3-1H-Grenade Area-PR	86	1.24	3.15	0.37	1.79
M3-1H-Mixed Use Area-D	169	4.20	5.13	0.51	1.20
M3-1H-Rocket Area-D	13	1.06	0.95	1.03	0.28
M3-1H-Rocket Area-PR	20	0.25	0.72	0.25	0.50
M3-1L-37mm Projectile Area-D	180	4.91	0.0088	4.91	0
M3-1L-Mixed Projectile Area-PR	370	7.00	3.30	0.53	0.17
M3-Remainder Area-PR	1,043	14.71	19.78	14.71	11.43
M3-1L-Rocket Area-D	115	1.47	4.91	0.49	0.0
M3-1L-Suspect Area 1-PR	193	4.94	0.42	3.95	0.14
M3-1L-Suspect Area 2-PR	9	0.0	0.11	0.0	0.019
M3-2H-Mortar Area-D	42	0.74	1.89	0.017	0.20
M3-2H-Mortar Area-PR	104	1.51	2.98	0.25	0.32
M3-2M-Hand Grenade Area-PR	70	3.00	2.57	0.0	0.0
M3-3H-Rocket and Hand Grenade Area-D	97	0.50	8.72	0.0	2.26
M4-1H-Mixed Use Area-PR	623	41.4	4.29	6.01	0.0
Totals	**3,325**	**94.7**	**88.31**	**34.77**	**19.65**

NOTES:
[1] Based on the fraction of the identified target anomalies intrusively investigated in each geophysically surveyed grid or transect segment.
[2] Includes cluster, delineation, and mountain transects.

4.5 THE ORDNANCE AND EXPLOSIVES RISK IMPACT ASSESSMENT

4.5.1 Introduction

TtEC applied the Interim OERIA Guidance (USACE, 2001) methodology to evaluate the level of potential exposure to OE and corresponding level of OE protectiveness indicated to exist in the various sectors of the Bravo Area. The OERIA process was developed by representatives of the U.S. Army Corps of Engineers as a stakeholder-friendly method of qualitative risk assessment used for OE site EE/CAs. The OERIA process is based on the premise that OE risk is assessed in large measure and presented for purposes of communication with the site stakeholders, rather than to explicitly quantify it. Application of OERIA to the Bravo Area involved the direct analysis of site conditions relative to the:

- Nature of OE present, or suspected of being present, in each area.
- Characteristics of the accessibility and stability of each area.
- Recreational or occupational activities expected to be performed in the area under projected future land use.

4.5.1.1 Each basic (default) OERIA risk factor was critically considered in the context of Fort McClellan. Two of the basic factors, Site Accessibility and Site Stability, were retained in their default form. Several of the risk factors were tailored, modified, or quantitatively evaluated. Please refer to paragraph 4.5.2.1.4 for details.

4.5.1.2 These particular factors were highlighted because of their role in determining or affecting the level of risk posed by OE that may be present in an area. Information on these factors was compiled and evaluated to develop a qualitative assessment of the potential for exposure to OE and overall protectiveness in each risk assessment sector. The OERIA process was applied to develop a baseline estimate of the potential for exposure given current site conditions and known site activities. The process was then applied again for each risk assessment sector to evaluate the potential for exposure to OE assuming the conduct of the activities likely to be associated with the future development or Passive Recreational use of Bravo Area. The first assessment, current use, was performed assuming conditions relating to the presence of OE in each sector and the characteristics of the sites themselves remain as they were observed during the site characterization or prior investigation efforts. The second assessment, future use was then performed assuming that each candidate response action alternative would be implemented as defined below with the goal of altering one or more of the factors that affect the level of protectiveness against OE exposure during the human activities projected for that area. The results of these risk assessments were used as major inputs to the Effectiveness Criterion used later in the comparative evaluation of alternative response actions (see Chapter 7.0). Results of the OERIA for each OE Risk Assessment Sector are summarized in Chapters 8.0 through 24.0, respectively.

4.5.2 Performance of the OERIA Risk Assessment

The OERIA process for Bravo Area was applied in three sequential steps. As noted below, the area within an OE Risk Assessment Sector must have similar OE characteristics and similar projected future activities. As such, an analysis of the site characterization data was made (as described below) that determined the site Characterization Sectors that needed to be further divided prior to the risk assessment due to marked differences in the amount or nature of OE that is projected to be present. In addition, the future land use plan (EDAW, 1997) for Bravo Area was considered to ensure that the OE Risk Assessment Sectors are also projected to have internally similar future activities and likely levels of interaction with the ground. The key aspects of each of the three following OERIA steps, as outlined in published guidance, for the seventeen resulting OE Risk Assessment Sectors of Bravo Area are described in the paragraphs that follow.

- Step 1 - Reviewed the base OERIA risk factors and identified any additional site-specific risk factors needed to better assess or communicate the OE-related risks at this site.
- Step 2 - Performed the baseline risk assessment for each area.
- Step 3 - Assessed the level of OE protection afforded by each candidate response action alternative for each area.

4.5.2.1 OERIA Step 1: Risk Factor Selection

This step of the OERIA process established the factors judged to be important in considering and communicating OE risk in the specific context of Fort McClellan. The basic OERIA risk factors were the starting point for this identification process. These basic factors are listed below in Table 4-3. They are associated with the nature and distribution of the ordnance items present, the physical characteristics of the site being assessed, and factors describing the type and scale of human activity likely to be conducted in that area. These basic risk factors are further described in the following sections.

Table 4-3
The Basic OERIA Risk Factors

Ordnance Risk Factors				Site Risk Factors		Human Risk Factors	
Type	Sensitivity	Depth	Quantity or Density	Accessibility	Stability	Activities	Population

4.5.2.1.1 Basic OERIA Ordnance Risk Factors

- Ordnance Type - The Type of OE present affects the likelihood of injury and the severity of a potential incident involving that OE. The OERIA documentation defines four categories for this factor, from Category 0 (inert OE or scrap that could cause no explosive injury) to Category 3 (OE that will kill an individual if detonated as the result of that individual's activities).
- Ordnance Sensitivity - OE Sensitivity affects the likelihood of the item detonating or releasing energy if encountered and disturbed. The OERIA documentation defines four

general categories for this factor, from Category 0 (inert OE or scrap that could cause no explosive injury) to Category 3 (OE that is very sensitive).

- Ordnance Depth - OE depth on or beneath the surface of the ground affects the likelihood that an individual will be exposed as the result of his or her activities.
- Ordnance Quantity or Density - OE quantity or density affects the likelihood that an individual will be exposed to OE. There is an assumed direct relationship between OE density and the potential for harm. The presence of more OE items is expected to present more potential for exposure. The OERIA documentation specifies that the distribution, location, and the characteristic density of OE be described.

4.5.2.1.2 Basic OERIA Site Risk Factors

- Site Accessibility - The accessibility of the site affects the likelihood of people being exposed to OE. Any man-made barriers (e.g., walls or fences) or natural barriers (e.g., terrain, topography, or vegetative cover) that preclude or limit access to the site are considered relative to their effectiveness in limiting or controlling accessibility to the site. The OERIA documentation defines three categories for this factor, from "Complete Restriction to Access" (where all points of entry are controlled) to "No Restrictions to Site" (No man-made barriers, gently sloping terrain, no vegetation or bodies of water that restrict access).
- Site Stability - Site stability affects the likelihood of coming into contact with OE as the result of recurring natural processes (e.g., frost heave, sand movement, or erosion) or because of extreme natural events (e.g., tornadoes, earthquakes, or hurricanes). The OERIA documentation defines three categories for this factor, from "Site Stable" (where OE should not be exposed by natural events) to "Site Unstable" (where OE is most likely to be exposed by natural events).

4.5.2.1.3 Basic OERIA Human Risk Factors

- Human Activities - The types of activities conducted at a site are related to the likelihood of people coming into contact with OE. The activities are generally classified as "recreational" (e.g., hiking, biking, or camping) or "occupational" (e.g., farming, industrial, retail, or construction). The OERIA process also considers the contact probability level associated with an activity or set of similar activities. The OERIA documentation defines three categories for this factor: "Low", "Moderate", and "Significant". In general, recreational activities are projected to have a higher contact probability for the surface and near-surface soils, and lower contact probabilities relative to deeper soils (i.e., greater than six inches below the ground surface). Activities associated with redevelopment or occupational land uses are anticipated to disturb the soil to greater depths and have higher contact probabilities at these greater depths than the recreational activities. The OERIA guidance states to use the minimum depth of OE found in the area as the depth to consider in the analysis.
- Human Population - The population or number of people using the site affects the likelihood of encountering OE. Again, there is an assumed direct relationship between the number of people using the area and the potential for harm. The presence of more people conducting activities in the area or a fixed number of people using the area more frequently is expected to present more potential for exposure. The OERIA documentation suggests that an estimate

of the number of people using the site can be made based on the type of site, access restrictions, population, or other demographic information.

4.5.2.1.4 Tailoring and Adding Site-Specific Risk Factors

Each set of basic OERIA risk factors was critically considered in the context of Fort McClellan, the Bravo Area, and the site stakeholders. The following discussion summarizes how each of the basic OERIA risk factors was either retained in its basic form, tailored in some manner to better fit conditions or circumstances at Bravo Area, or was supplemented with a new or related factor.

4.5.2.1.4.1 Ordnance Risk Factors

The site-specific considerations associated with the OERIA ordnance risk factors are noted below:

- Presence/Absence of High Explosives (HE) - A general measure of the conditions in an area relative to possible OE exposure is whether or not HE ordnance items or HE debris has been found in the area. The presence or absence of HE items or debris is partially related to the next risk factor, OE Type. The presence or absence of HE in the area was considered useful information relative to the OERIA assessment and subsequent risk management decision making.
- OE Type - This OERIA risk factor was retained in its basic form. However, the percentage of the OE items found during the investigations in each OERIA OE Type category was also calculated and presented. The presentation of the available information was judged to be more informative than just noting the most hazardous category associated with the OE item(s) that have been found in the area.
- OE Sensitivity - This OERIA risk factor was retained in its basic form. However, the percentage of the OE items found during the investigations in each OERIA OE Sensitivity category was also calculated and presented. The presentation of the available information was judged to be more informative than just noting the most sensitive category associated with the set of OE items found during the intrusive investigations.
- OE Item Depth Distribution/Item Density - The percentage of the OE items found during the EE/CA and prior investigations within a set of pre-defined depth intervals was calculated and presented for each risk assessment sector. The depth ranges of interest included the ground surface, from the surface down to one foot below the surface, and deeper than one-foot. The indicated average OE Item Density was chosen for use in the OERIA assessment over the absolute quantity of OE in the sector. One measure can, however, be calculated from the other using the investigation area reported for each risk assessment sector. The indicated OE Debris Depth Distribution and OE Debris Density were also judged to be useful characterization data to consider during the qualitative risk assessment. A comparison of the OE Debris Depth Distribution and Density with the OE Item Depth Distribution and Density enables the consistency and the quality of the data to be checked, and allows the applicability of the conceptual model of the ordnance-related activities in the area to be further tested. It must be emphasized that the average OE Debris Depth Distribution and average Density were not used directly in the OE risk assessment or the comparative evaluation of the candidate response alternatives, and that OE Debris characteristics were not used as

surrogates for energetic OE Item characteristics when no energetic OE Items were found during the characterization efforts.

4.5.2.1.4.2 Site Risk Factors

The site-specific considerations associated with the OERIA site risk factors are noted below:

- Site Accessibility - This was retained in its basic form.
- Site Stability - This was retained in its basic form.

4.5.2.1.4.3 Human Risk Factors

The site-specific considerations associated with the OERIA human risk factors include the following:

- Activities - This OERIA risk factor was retained in its basic form. However, a separate evaluation was made of known current use activities and anticipated future use activities (e.g., site redevelopment or reuse) based on the most recent reuse projection for Fort McClellan (see discussion above in 4.2.2).
- OE Contact Probability Level - This OERIA risk factor was retained in its basic form. However, a separate evaluation was made regarding the likelihood of contact relative to the anticipated depths of intrusion associated with the current and projected future use activities.
- Population - This OERIA risk factor was retained in its basic form. However, a separate qualitative evaluation was made of the probable number of individuals conducting activities in the area under current and future use scenarios.
- Likelihood of Near Term Reuse - Redevelopment and reuse of the Bravo Area in the near term was considered very likely. This element of the overall Bravo Area characterization was considered important enough to highlight and retain in the forefront of the risk and protectiveness assessment. This was based on the approved 1997 Reuse Plan (EDAW, 1997).

4.5.2.1.4.3.1 The establishment of the risk factors, comprised of the basic OERIA risk factors with the noted tailoring and supplemental information, completes Step 1 of the OERIA process.

4.5.2.2 OERIA Step 2: Baseline Risk Assessment

This step of the OERIA process involved compiling and documenting what is known about the set of risk factors established for the site for each risk assessment sector. The basis for this assessment is the conditions at the site as they currently exist consistent with the information gathered to date. The first rows of the OERIA tables contain the results of the baseline risk assessment for each risk assessment sector. Wherever appropriate, the OERIA factor definitions contained in the Interim OERIA Guidance were used (as noted above). Other site-specific definitions or modifications of the Interim Guidance definitions were defined or documented in the text or footnotes to the OERIA tables. Some general comments on how the various risk factors were interpreted or assigned values are presented below.

4.5.2.2.1 Ordnance Risk Factors

- Presence/Absence of High Explosives - The sets of OE items and OE debris found during the EE/CA site characterization work or previous investigations in each risk assessment sector were reviewed (as applicable) to determine if HE ordnance or debris was associated with the area.
- OE Type - The OE Type category definitions and descriptions included in Table 1 of the Interim OERIA Guidance were used. Care was taken to consistently assign a category to particular OE items found in different parts of the overall Bravo Area through the compilation of some rules to clarify the definitions. These rules are presented as an extension to the Guidance table in Table 4-4. Items that presented no risk were assigned a Category 0. If an OE item, no matter whether practice or real, posed any residual risk it was assigned a Category 1 status at a minimum. If it was determined that there was no risk or the item was not functional, it was assigned a Category 0 status. Having assigned categories to all the OE items found in the sector, the percentages of each category were calculated.

Table 4-4
OE Categories with Descriptions

Category	Description	Assignment Rules
3	OE that will kill an individual if detonated by an individual's activities	All high explosive (HE) filled items (fired or unfired) Any item whose identity was unspecified or undetermined (conservative default assumption) [Examples: 81mm HE M43 mortar (Fired), 37mm HE MKII projectile (Fired), 2.36" HEAT M6 rocket (Fired).]
2	OE that will cause major injury to an individual if detonated by an individual's activities	All non-HE filled, non-practice items Any fuze that was separated from ordnance item that cannot positively be identified as functioning [Examples:, Smoke Hand Grenade and Rifle Grenade]
1	OE that will cause minor injury to an individual if detonated by an individual's activities	All practice ordnance (fired or unfired) Items with no explosive filler, but including a fuze, detonator or spotting charge [Examples: M69 practice hand grenade with live fuze, 2.36" M7 practice rocket (unused), M11 practice rifle grenade]
0	Inert OE or scrap, will cause no injury	All non-energetic items

NOTE: If a number of like items were found in an area and the level of identification information associated with these items was not complete, the conservative assumption was made that the incompletely specified items were similar to the more completely specified items of that type with the highest (most hazardous) assigned category.

- OE Sensitivity - The OE Sensitivity category definitions included in Table 2 of the Interim OERIA Guidance were used. Again, care was taken to consistently assign a category to particular OE items found in different parts of the overall Bravo Area through the compilation of some rules to clarify the definitions. These rules are presented as an extension to the Guidance table in Table 4-5. Having assigned categories to all the OE items found in the sector, the percentages of each category were calculated.

Table 4-5
Category Descriptions and Assignment Rules for the OE Sensitivity Risk Factor

Category	Description	Assignment Rules
3	OE that is very sensitive	All high explosive (HE) filled items that have been fired All 40mm HE grenades or LAW munitions Any item whose fuzing was unspecified or undetermined (conservative default assumption)
2	OE that is less sensitive	Any item not classified as Category 3, 1, or 0
1	OE that may have functioned correctly or is unfuzed but may have a residual risk	All practice ordnance (fired or unfired) All abandoned or new unfuzed and unfired items
0	Inert OE or scrap, will cause no injury	All non-energetic items

NOTE: If a number of like items were found in an area and the level of identification information associated with these items was not complete, the conservative assumption was made that the incompletely specified items were similar to the more completely specified items of that type with the highest (most sensitive) assigned category.

- OE Item Density/Depth Distribution - The indicated overall average OE Item Density was calculated by dividing the number of OE items found in the intrusively investigated portion of the Characterization Sector by the amount of acreage intrusively investigated. The OE Item Density was also calculated for each depth range by dividing the number of items found in that depth range by either the geophysically surveyed area (for ground surface) or the intrusively investigated area (for 0 to 1 foot below the surface and deeper than 1 foot below the surface). The 90 percent confidence interval was calculated on the overall OE item density by using the UXO Calculator (Version 1.4.2). It represents a 90 percent two-sided confidence interval for the OE Item Density (when energetic OE items were found) or a 90 percent one-sided confidence interval for the OE Item Density (when no energetic OE items were found). Having identified the depths in the soil at which all the OE items were found in the Characterization Sector, the percentages of items found in each of three defined depth intervals (e.g., surface, 0 to 1 foot below the surface, and deeper than 1 foot below the surface) were calculated. Densities and depth range percentages shown in italics and curly brackets indicate the characteristics of the OE Scrap found in that area.

4.5.2.2.2 Site Risk Factors

- OE Site Access - The OE Site Access definitions included in Table 3 of the Interim OERIA Guidance were used. The Guidance table is reproduced as Table 4-6. While access to certain portions of Fort McClellan are restricted and the access controls are strictly enforced, the majority of the Bravo Area is generally accessible to the public without enforced restriction or physical barriers. In addition, the terrain in the Bravo Area sectors is not so severe as to restrict access on a large scale in any sector. As such, the current conditions in all Bravo Area sectors were characterized as "No Restriction to Site". Assuming future site

redevelopment, unrestricted site access would be necessary for practical commercial, industrial, cultural, or recreational reuse. Therefore, the same "No Restriction to Site" classification was assumed as the required baseline for the future land use scenario.

Table 4-6
Category Descriptions for the OE Site Access Level

Access Level	Access Description
No Restriction to Site	No man-made barriers, gentle 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

- OE Site Stability - The OE Site Stability definitions included in Table 4 of the Interim OERIA Guidance were used. The Guidance table is reproduced as Table 4-7. The Bravo Area sectors are not subject to recurring natural processes (e.g., frost heave, sand movement, or erosion) on a large scale. Certain portions of the sectors may be subject to minor erosion over a limited area. The Bravo Area sectors are also not routinely subject to extreme natural events (e.g., tornadoes, earthquakes, or hurricanes). As such, these areas were all classified as "Site Stable" (where OE should not be exposed by natural events) for the baseline assessment under both current and future land use scenarios.

Table 4-7
Category Descriptions for OE Site Stability

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

4.5.2.2.3 Human Risk Factors

The human risk factors were assessed for a current land use scenario of Recreational. A separate evaluation was performed for either a future Cultural, Development Reserve, Retail, Mixed Business Use, or Active Recreation (collectively considered as “Development”) or Passive Recreation scenario consistent with the land use projected for each OE Risk Assessment Sector (residential re-use also was assessed for the M3-Remainder Area-PR sector). Considerations relative to these assessments are presented in the following paragraphs.

4.5.2.2.3.1 Current Land Use Scenario

- Activity - A predominantly recreational scenario was judged to best represent the current land use in the Bravo Area risk assessment sectors. The typical activities associated with these areas prior to the start of the clean-up effort include hunting, hiking, and short cuts. Exposure to terrestrial wildlife is also assumed to potentially occur under this scenario.
- OE Contact Probability Level - The OE Contact Probability Level definitions included in Table 5 of the Interim OERIA Guidance were used. The typical activities associated with the current land use in the Bravo Area are hunting, hiking, and short cuts. The OE depth used in the evaluation of this risk factor was the shallowest depth that OE items were found in that Characterization Sector. The Guidance table is reproduced as Table 4-8.

Table 4-8
Category Descriptions for the OE Contact Probability Level

Examples of Activities	Shallowest OE Depth	OE Contact Probability
Child Play, Short Cuts, Hunting, Fishing, Hiking, Swimming, and Jogging	0"-6”	Significant
	6”-12”	Low
	> 12”	Low
Picnic, Camping, Metal Detecting	0"-6”	Significant
	6”-12”	Moderate
	> 12”	Low
Construction, Archaeology, Crop Farming	0"-6”	Significant
	6”-12”	Significant
	> 12”	Moderate

- Population - Three different levels of frequency of usage of the site by the local population were defined on a site-specific basis to characterize the magnitude of potential human exposure: “Rare”, “Occasional”, and “Frequent”. In consideration of the activities likely to occur in the Bravo Area under the current land use scenario, the population frequency of usage was judged to be "Rare" due to the restrictions placed on the site (i.e., no hunting or hiking) since remediation activities began. The frequency of site usage prior to the start of the remediation effort was judged to be "Occasional" if the routine recreational activities at that time were allowed to continue.

4.5.2.2.3.2 Future Land Use Scenario

- Activity - The projected future use of the various portions of Bravo Area was previously discussed in 4.2.2. Based on this projection, the Bravo Area includes eight different land use designations: Cultural, Development Reserve, Retail, Mixed Business Use, Eastern Bypass (i.e., transportation), Active Recreation, Passive Recreation, and (in one area) residential reuse. It must be emphasized that the differences in projected land use were explicitly considered in the definition of the risk assessment sectors. The type of activities associated with each of these land uses was presented in 4.2.2.
- OE Contact Probability Level - The reproduced Guidance table, Table 4-8, was also used to assign the risk for future land use scenarios. The activities associated with the projected future land uses in the Bravo Area were described above, along with the extent to which intrusion into the soil is expected in association with each category of activity.
- Population - The same three levels of frequency of usage of the site by the local population were used to characterize the magnitude of potential human exposure that may be associated with each risk assessment sector under the future use scenario. The population risk factor was assessed to be “Occasional” for the Passive Recreation future land use, and “Frequent” for the set of future land uses associated with Development (including Residential Reuse).

4.5.2.3 OERIA Step 3: Assess Candidate Response Action Alternatives

After the Baseline Risk Assessment was completed, six candidate response action alternatives were assessed for each of the seventeen OE Risk Assessment Sectors. The OERIA risk factors were estimated assuming the successful implementation of each alternative. The response

alternatives were comparatively ranked with respect to their impact on protectiveness and reducing OE-related exposure and risk in each area.

4.5.2.3.1 The Candidate Response Action Alternatives

The candidate response action alternatives evaluated for each OE Risk Assessment Sector in the Bravo Area are summarized in Table 4-9. These alternatives are discussed in greater detail in Chapter 7.0 of this report.

4.5.2.3.2 Assessment of the Candidate Response Action Alternatives for Each OE Risk Assessment Sector

Each of these six response action alternatives were evaluated with respect to their anticipated impact on the risk factors established for the seventeen Bravo Area OE Risk Assessment Sectors. Each response action alternative was assessed and scored using the same process used for the baseline assessment. Once all six alternatives were scored relative to their impact on reducing potential OE exposures, the alternatives were assigned an overall relative ranking using best professional judgment in consideration of all available information. The published documentation for the OERIA methodology does not provide specific guidance on how an overall ranking should be developed. This guidance also does not place limits or otherwise constrain this development. As such, a simple but systematic approach was used to generate an overall ranking of the response action alternatives with respect to OE exposure potential and protectiveness. This approach was based in large measure on professional judgment, logic, and an explicit effort to maintain consistency across the selected OERIA risk factors and the different candidate response action alternatives. All the identified risk factors (ordnance, site, and human) were considered in the development of the overall protectiveness ranking for each response action alternative. The relationship of these factors for the area with regard to both current and projected land use was collectively evaluated to develop the overall protectiveness ranking for each alternative. An overall protectiveness ranking was collectively developed for each alternative for that area for current and projected future land use. The protectiveness levels that were used include:

- HIGH - Assigned to the alternative or set of alternatives with the best level of OE protectiveness or risk reduction relative to existing conditions and the projected activities for that area. This ranking was assigned when the implementation of the response action alternative was projected to eliminate exposure to OE throughout the entire sector given the depth distribution of OE observed during the characterization work and the nature of the activity associated with the current or future land use.
- <u>MODERATE</u> - Assigned to alternatives with a level of protectiveness or risk reduction greater than LOW and less than HIGH. This ranking was assigned when the implementation of the response action alternative would reduce exposure to OE to some degree for the majority of potential users throughout the entire sector or for a subset of specific users within a portion of the sector (i.e., construction workers within the construction footprint).

Table 4-9
Response Action Alternatives Addressed in the Risk Assessment

Alternative	Description
No Further Action	The No Further Action alternative involves no additional action at the site and therefore, depending on results of the site characterization may leave undiscovered OE in the environment that could pose a potential risk to the public. This alternative does not impose any land use controls (i.e., as described below for Alternative 2). This alternative includes a deed notice in the property transfer documents that informs future property owners of the history of OE use and provides notification procedures in the event an OE item is discovered. Such a deed notice was considered a part of all alternatives evaluated for this EE/CA. This alternative was evaluated for each sector of the Bravo Area as a baseline for comparing other alternatives.
Alternative 2 - Area-Specific Land Use Controls	This alternative involves minimizing or controlling potential risk associated with exposure to the public or the environment associated with the OE within an area using area specific land use controls. These land use controls may consist of one or more institutional or engineering controls tailored to an area or location, including a deed restriction that prohibits digging in the area without construction support by UXO-qualified personnel, signage, and/or periodic inspection and maintenance activities associated with the signs. Selection of this alternative would require compliance with the Land Use Assurance Plan (LUCAP), a joint agreement between the EPA, ADEM, the U.S. Department of the Army (DA) for Fort McClellan, FMC and the JPA. The LUCAP lays out the process for determining when land use controls are needed, how land use control plans will be developed, and specifies responsibilities for monitoring and enforcement.
Alternative 3 - Construction Support	This alternative includes providing surface and subsurface clearance of OE in designated areas where construction activities are planned. UXO-qualified personnel, using metal detection instruments, would detect OE items that may exist on or below the ground surface in areas where intrusive building activities are planned. Any OE located during this action will be inspected to ensure its stability and disposed of in accordance with a previously approved work plan and approved procedures.
Alternative 4 - Surface Clearance	This alternative involves removal of surface OE from the site. Surface clearance involves detecting and removing those OE items exposed or partially exposed on or above the ground surface. The area would be divided into survey grids and a visual search would be conducted by UXO personnel aided by suitable detection instruments. Discovered items known or suspected to be OE will be marked with a pin flag for later disposition. After identification, the item will be disposed of as scrap or OE in accordance with a previously approved OE operations work plan. Land surveying and brush clearing operations would be a necessary component of this alternative. This alternative will include a deed restriction that prohibits digging in the study area without construction support by UXO-qualified personnel.
Alternative 5 - Clearance to One Foot Depth	This alternative includes the surface and subsurface clearance of OE items to a depth of one foot. This depth was selected based on site-specific information, future land use, the type of ordnance items that have been found in the vicinity and that may be present within the study area, and typical penetration depths for the types of OE items that may be present. Implementation of this alternative will require land surveying and brush clearing operations to prepare the site. Where technically feasible, suitably sensitive detection instruments will be used to survey the study area and locate subsurface anomalies. These anomalies subsequently will be investigated down to 12 inches. After identification, the item will be disposed of as scrap or OE in accordance with a previously approved OE operations work plan. In some areas, this alternative will include a deed restriction that prohibits digging in the study area without construction support by UXO-qualified personnel.

Table 4-9
Response Action Alternatives Addressed in the Risk Assessment

Alternative	Description
Alternative 6 Clearance to Depth	This alternative includes the surface and subsurface clearance of OE items to a depth corresponding to the maximum depth of detected OE in each area. Under this alternative, investigation/excavation of an anomaly (i.e., suspect OE item) will continue until the source of the anomaly is found or until it is determined that no detected OE item is present. This alternative differs from Alternative 5 in that the depth of clearance is not limited to one foot. Implementation of this alternative would require land surveying and brush clearing operations. After the area is cleared of surface contamination, a subsurface investigation will be conducted. Due to the requirement to detect items deeper than one foot, this alternative would be performed using sensitive instruments capable of detecting anomalies at greater depths. Using a suitably sensitive detection system, the entire study area will be surveyed to locate potential OE items. The anomalies will then be investigated to identify them as OE, OE debris, or non-OE debris (metallic scrap). After identification, the items will be disposed of as scrap or OE in accordance with the previously approved OE operations work plan

- LOW - Assigned to the alternative or set of alternatives with the lowest level of OE protectiveness or risk reduction relative to existing conditions and the projected activities for that area. This ranking was assigned when the implementation of the response action alternative was projected to result in potential exposure to OE throughout the entire sector given the depth distribution of OE observed during the characterization work and the nature of the activity associated with the current or future land use.
- BASELINE - Assigned protectiveness level for Alternative 1 - No Further Action.

4.5.2.3.2.1 Once the overall OERIA rankings for all candidate response action alternatives for a given OE Risk Assessment Sector were developed, the set of rankings was reviewed collectively to ensure that ordering is consistent with the risk factor scores that were used to develop it. The rankings also were examined to look for possible inconsistencies across the various risk factors considered in the assessment.

4.5.2.3.3 Summary of the Overall Protectiveness Rankings for Each Response Action Alternative for Each OE Risk Assessment Sector

The overall protectiveness rankings for the response action alternatives in each OE Risk Assessment Sector are developed and discussed in Chapters 8.0 through 24.0, respectively. The results from these evaluations are compiled below in Table 4-10. A summary of how these rankings were developed, in consideration of all of the sector-specific evaluations, is presented in the paragraphs that follow.

Table 4-10
Overall Protectiveness Ranking for the Candidate Response Action Alternatives for Each Bravo OE Risk Assessment Sector

	Response Action Alternatives					
OE Risk Assessment Sector	**Alternative 1 No Further Action**	**Alternative 2 Area Specific Land Use Controls**	**Alternative 3 Construction Support**	**Alternative 4 Surface Clearance**	**Alternative 5 Clearance to One Foot Depth**	**Alternative 6 Clearance to Depth**
A-1 Reconnaissance Area-D (See Figure 8-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Low	High	High
Future Use	Baseline	Low	Moderate [1]	Low	Moderate	High
M3-1H-Grenade Area-D (See Figure 9-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Moderate	High	High
Future Use	Baseline	Low	Moderate [1]	Low	Moderate	High
M3-1H-Grenade Area-PR (See Figure 10-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Moderate	High	High
Future Use	Baseline	Low	Moderate [1]	Moderate	High	High
M3-1H-Mixed Use Area-D (See Figure 11-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Low	High	High
Future Use	Baseline	Low	Moderate [1]	Low	Moderate	High
M3-1H-Rocket Area-D (See Figure 12-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Low	High	High
Future Use	Baseline	Low	Moderate [1]	Low	Moderate	High
M3-1H-Rocket Area-PR (See Figure 13-2)						
Current Use [3]	Baseline	Moderate	High [1]	High	High	High
Future Use	Baseline	Moderate	High [1]	High	High	High
M3-1L-37mm Projectile Area-D (See Figure 14-2)						
Current Use [3]	Baseline	Low	Moderate [1]	High	High	High
Future Use	Baseline	Low	Moderate [1]	Moderate	Moderate [2]	High
M3-1L-Mixed Projectile Area-PR (See Figure 15-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Low	High	High
Future Use	Baseline	Low	Moderate [1]	Low	High	High
M3-Remainder Area-PR (See Figure 16-2) [Passive Recreation Future Use]						
Current Use [3]	Baseline	Moderate	High [1]	High	High	High
Future Use	Baseline	Moderate	High [1]	High	High	High
M3-Remainder Area-PR (See Figure 16-3) [Residential Future Use]						
Current Use [3]	Baseline	Moderate	High [1]	High	High	High
Future Use	Baseline	Moderate	High [1]	High	High	High
M3-1L-Rocket Area-D (See Figure 17-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Moderate	Moderate [2]	High
Future Use	Baseline	Low	Moderate [1]	Low	Low [2]	High
M3-1L-Suspect Area 1-PR (See Figure 18-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Moderate	High	High
Future Use	Baseline	Low	Moderate [1]	Moderate	High	High
M3-1L-Suspect Area 2-PR (See Figure 19-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Low	High	High
Future Use	Baseline	Low	Moderate [1]	Low	High	High
M3-2H-Mortar Area-D (See Figure 20-2)						
Current Use [3]	Baseline	Low	Moderate [1]	High	High	High
Future Use	Baseline	Low	Moderate [1]	Moderate	Moderate [2]	High

Table 4-10
Overall Protectiveness Ranking for the Candidate Response Action Alternatives for Each Bravo OE Risk Assessment Sector

	Response Action Alternatives					
OE Risk Assessment Sector	**Alternative 1 No Further Action**	**Alternative 2 Area Specific Land Use Controls**	**Alternative 3 Construction Support**	**Alternative 4 Surface Clearance**	**Alternative 5 Clearance to One Foot Depth**	**Alternative 6 Clearance to Depth**
M3-2H-Mortar Area-PR (See Figure 21-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Moderate	High	High
Future Use	Baseline	Low	Moderate [1]	Moderate	High	High
M3-2M-Hand Grenade Area-PR (See Figure 22-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Moderate [2]	High	High
Future Use	Baseline	Low	Moderate [1]	Moderate [2]	High	High
M3-3H-Rocket/Hand Grenade Area-D (See Figure 23-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Moderate	High	High
Future Use	Baseline	Low	Moderate [1]	Moderate	Moderate [2]	High
M4-1H-Mixed Use Area-PR (See Figure 24-2)						
Current Use [3]	Baseline	Low	Moderate [1]	Low	High	High
Future Use	Baseline	Low	Moderate [1]	Low	High	High

NOTES:
(1) Considered the most protective alternative within the construction footprint, although, this alternative is less protective relative to the overall sector and the full range of projected activity.
(2) Protectiveness reflects land use-based intrusion depths; The actual level of protectiveness achieved in this area may be greater given the observed depth distribution of OE items.
(3) Current Use is defined as "Recreational".
(4) Protectiveness may be greater given the effect of the deed restriction prohibiting digging.

4.5.2.3.3.1 Ordnance Risk Factors

Ordnance-related risk factors were important contributing factors to the overall protectiveness ranking. Given the relatively small number of live ordnance item finds, a defensible differentiation of ordnance types or sensitivity with depth in the soil could not be made. Consequently, a clear impact on these two risk factors could only be made by removing all OE items projected to be present. The remaining ordnance risk factor is OE Item Density, which can only be impacted by the clearance of some or all of the OE items projected to be present. Relative to Alternatives 4 through 6 (i.e., Surface Clearance through Clearance to Depth), deeper clearance results in greater protectiveness, as long as the deeper clearance is projected to remove more OE items. Alternative 3 - Construction Support is difficult to compare directly to the other clearance alternatives. This alternative is assumed to remove all detected OE items within the footprint of the projected construction activity, but no items that may be present at any depth outside of this boundary. In contrast, Alternatives 4 through 6 were assumed to remove all detected OE items to some depth over the entire spatial extent of the OE Risk Assessment Sector. Alternative 6 - Clearance to Depth was assumed to remove all detected items within the entire sector boundary, which would result in the greatest level of protectiveness relative to the entire sector and the primary set of individuals projected to be conducting activities within the sector. Clearance to a lesser depth throughout the sector would lead to less protectiveness, unless no OE items were found at the shallower depths being cleared. Given this difference of impact (complete removal in a limited area versus partial removal over the entire area), a direct

comparison between Alternative 3 - Construction Support and Alternatives 4 through 6 cannot be made on completely equal terms. Alternative 3 would represent the best alternative with respect to the ordnance risk factors relative to the construction footprint and the protection of projected construction workers. Alternative 4, 5, or 6 would represent the best alternative with respect to the ordnance risk factors in consideration of the entire sector and all potential receptors participating in recreational or industrial activities. It should be noted that the OE Debris Density and Depth Distribution characteristics were not used in the evaluation of the alternative candidates. This information was presented in the OERIA tables to provide additional context for the actual OE item discoveries.

4.5.2.3.3.2 Site Risk Factors

The site-related risk factors are site accessibility and site stability. However, given the exclusion of any access controls (e.g., enforced security, fencing, physical barriers) from any of the evaluated alternative response actions, the alternatives would have no projected impact on site accessibility, physical or institutional. In addition, the evaluated alternatives would not alter the basic physical stability of the site with respect to the potential for natural forces to bring OE items to the surface where they may be contacted more easily. As such, the site-related risk factors could not be used to effectively differentiate between the evaluated candidate alternatives for Bravo Area.

4.5.2.3.3.3 Human Risk Factors

With respect to the human behavior risk factors, the level of protectiveness associated with a particular alternative depends on whether the projected activities (currently or in the future) are likely to result in people intruding into the soil to the extent that OE items are encountered. These factors also depend on the projected number of people performing these activities or the frequency at which they perform them. A deed restriction prohibiting digging without construction support by UXO-qualified personnel is assumed for Alternatives 4 and 5. This restriction impacts both the passive recreation and development future land use where digging is assumed to take place, therefore limiting the potential exposure to OE that would be exposed due to digging. A land use control involving the installation of warning signs is an assumed part of Alternative 2. It is possible, given the installation of effective warning signs, that some individuals who may otherwise choose to conduct a potentially risky activity may opt not to, or to perform it somewhere where potential exposure to OE is not an issue. As such, any alternative including this area specific land use control was assessed to have a similar protective impact on the population risk factor. Alternatives without this land use control would have no impact on this factor. An alternative's impact on the OE Contact Probability Level was judged relative to the scale presented in Table 4-8, as taken from the OERIA Guidance. Passive Recreation land use was assumed to correspond to activities that involve interaction with the ground surface and near-surface soil (less than six inches below ground surface), with infrequent intrusion deeper into the ground. The Development land use activities were assumed to involve frequent intrusion into the soil to depths in excess of one foot. A response action alternative was projected to have a positive impact on protectiveness relative to the baseline condition (Alternative 1 - No Further Action) if the alternative would result in a change in the OE Contact Probability Level according to Table 4-8 (e.g., a shift from "Significant" to "Moderate" or a shift from "Moderate" to "Low"). This is accomplished, given a projected land use activity set, by increasing the depth of the shallowest OE present by performing clearance activities. If OE is

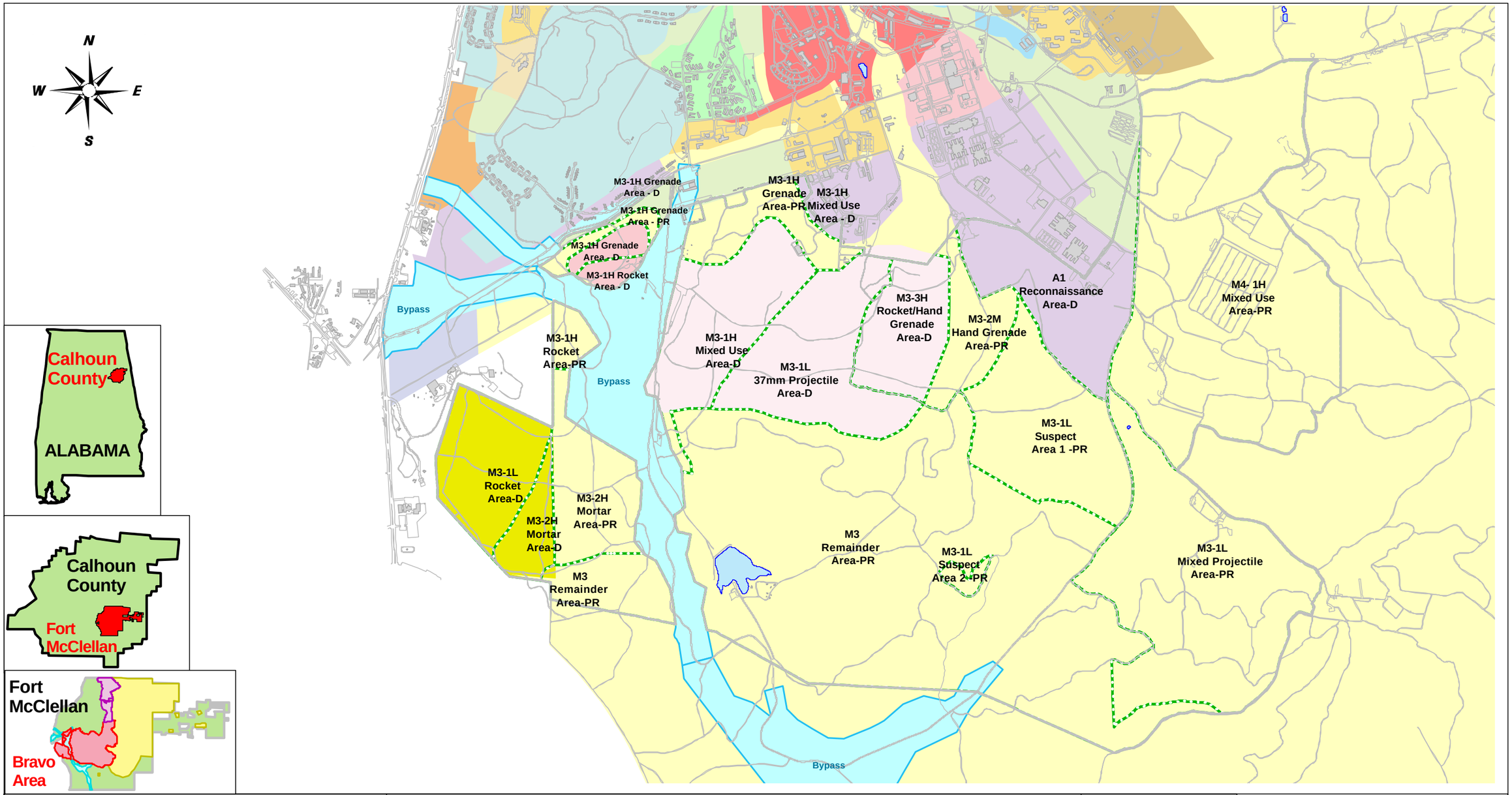
projected to be present, protectiveness was judged to be positively impacted by clearance to a foot or more in Passive Recreation areas. Protectiveness in Development land reuse areas was judged to be positively impacted somewhat by Clearance to One-Foot Depth with the greatest improvement by Clearance to Depth. Protectiveness within construction footprints was judged to be improved only by Clearance to Depth. If no OE items were projected to be present in an area, this factor was judged to be unimpacted by clearance. Considered together, differentiation of the level of protectiveness associated with the alternatives on the basis of human behavior risk factors is accomplished primarily through the reduction of the OE Contact Probability level through OE removal. Given the objective of reusing and redeveloping Bravo Area, the imposition of strict constraints or limits on the number of site users or the frequency of their use was not viewed as being consistent with the Land Use Control Assurance Plan (LUCAP). However, a small reduction on the number of individuals accessing the site and potentially being exposed to OE that may be present may result from the removal of the visible OE items and OE debris from the surface of the ground. The elimination of these items may reduce the number of souvenir hunters that may be drawn to areas where there are visible OE-related items.

4.5.2.3.3.4 Overall Rankings

The overall protectiveness rankings for each of the alternative response actions were summarized in Table 4-10. The overall rankings were largely influenced by the following risk factors:

- Ordnance - Deeper clearance positively increased protectiveness through all three factors as long as OE is projected to be present at those depths.
- Site - This factor has no projected impact on the assessment given the nature and definition of the candidate response actions considered.
- Human - Increased protectiveness was achieved when clearance was projected to eliminate or reduce the amount of OE present in the soil layer likely to be disturbed by current or future activities. Other elements of the response action alternatives are projected to have a much smaller, marginal impact on public protectiveness.

THIS PAGE INTENTIONALLY LEFT BLANK.



0 1000 2000 3000 4000 5000 6000

SCALE: 1" = 2000'

TETRA TECH EC, INC.

Legend

Land Use Areas by Type

- Active Recreation
- Cultural
- Development Reserve
- Town Center
- Eastern By-pass
- Education/Training
- Industrial
- Lake
- Mixed Business Use
- Public use
- Office
- Passive Recreation
- Retirement
- Residential
- Retail
- Retail/Office
- Bravo Study Area
- Bravo sectors
- Roads
- Buildings
- Lakes/Ponds

Figure 4-1

BRAVO AREA Projected Land Use

Fort McClellan, Calhoun County, Anniston, Alabama
December 2004

THIS PAGE INTENTIONALLY LEFT BLANK.

5.0 INSTITUTIONAL ANALYSIS

5.1 INTRODUCTION

An Institutional Analysis is commonly performed as part of the EE/CA process to identify the groups or institutions that have jurisdiction at the site, and their capability, stability and willingness to support the implementation and maintenance of land use controls. However, this analysis is more appropriate where the property has already been transferred into public or private ownership. In contrast, Fort McClellan is a former military reservation that is in the process of being transferred from the Federal government under the BRAC.

5.1.1 Recognizing that various forms of land use controls may be appropriate for areas of the Fort McClellan, a Memorandum of Agreement (MOA) among EPA, ADEM, DA on behalf of FMC and the TRADOC, and the JPA, was signed in December 2000. This MOA constituted the Land Use Control Assurance Plan (LUCAP). The LUCAP is included as Appendix G of this document.

5.2 PURPOSE OF THE LAND USE CONTROL ASSURANCE PLAN

The purpose of the LUCAP is to:

- Implement procedures to ensure the long-term effectiveness and viability of LUCs to protect human health and the environment.
- Raise the visibility of LUCs for parties, property owners and operators, local authorities, and the public in order to minimize the possibility of inadvertent violations of LUCs and provide a process for information exchange.
- Ensure that risk and land use assumptions upon which LUCs are based remain valid as long as the LUCs are relied upon to protect human health and the environment.
- Develop a system of redundant or layered land use controls.

5.2.1 If LUCs are selected as a final response action, a Land Use Control Implementation Plan (LUCIP) will be developed. The LUCIP will identify and describe each Land Use Control (LUC) placed on the site and include specific methods for ensuring that the effectiveness of each is maintained. The LUCIP will be coordinated among the Army, JPA, and/or other third parties, as appropriate; and regulatory agencies who are parties to the LUCAP (i.e., EPA, ADEM) will be afforded an opportunity to review and comment on each proposed LUCIP.

5.2.2 The LUCIP will specify who is responsible for monitoring, maintaining, and enforcing LUCs with the understanding that the Army remains ultimately responsible for its remedies. The LUCIP will identify the enforcement options available in the event that a LUC is violated.

5.2.3 Currently, a LUCIP describing interim LUC for the entire Bravo Area is in effect for Fort McClellan. Interim LUC were considered necessary to protect the public pending the results of the characterization activities in the EE/CA and decisions on response actions. Based on characterization and remedy decisions reached under the Consent Order between ADEM and the JPA, if final LUCs are required they will be documented in a decision document and described in a LUCIP.

6.0 IDENTIFICATION OF RESPONSE ACTION OBJECTIVES

6.1 INTRODUCTION

This chapter presents the response action objectives for the Bravo Area at Fort McClellan. A number of factors must be considered when establishing specific objectives for a response action. The objectives must be able 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. The alternatives considered for reducing the explosive threat posed by potential OE remaining in the Bravo Area must be effective, implementable, and economical. These criteria were used to evaluate the potential response action alternatives considered for the Bravo Area (see Chapter 7.0).

6.2 RESPONSE ACTION OBJECTIVES

The EE/CA is intended to determine the most effective alternatives that will meet the following response action objectives:

- Ensure protectiveness of site workers and public during all response action operations.
- Ensure overall protectiveness of the public after completion of the response action.
- Comply with ARARs to the extent practicable.
- Facilitate the intended future uses of the property.

6.2.1 The Army intends to comply with ARARs to the extent practicable. Ordnance poses a unique safety hazard or risk that must be considered in determining if it is "practicable" to comply with an ARAR. If an ordnance item is discovered and it is too unstable to move, it must be blown in place. For example, if an ordnance item is found next to a protected plant, the risk of harming the plant will be weighed against the risk of injuring the worker and potential members of the public that might come into contact with the ordnance item. In such a situation, human safety outweighs protection of the plant. Therefore a waiver of the ARAR that ordinarily requires protection of the plant would be appropriate.

6.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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 CERCLA site [40 Code of Federal Regulation (CFR) 300.5]. Relevant and appropriate requirements are cleanup standards and control standards, as well as the substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site, address problems or situations sufficiently similar to those encountered at a site where their use is well-suited (40 CFR 300.5). A requirement that is relevant and appropriate must be complied with to the same degree as if it were applicable. It is important to note that only those State

standards identified by the State in a timely manner and are more stringent than the Federal requirements may be considered ARARs (40 CFR 300.400(g)(4)).

6.3.1 Although the requirements of CERCLA Chapter 121 generally apply only to remedial actions as a matter of law, the U. S. Army's policy for OE removal actions is that ARARs will be identified and attained to the extent practicable. Two factors are applied to determine whether identifying and attaining ARARs is practical in a particular response situation. These factors include the urgency of the situation and the scope of the response action to be taken.

6.3.2 ARARs are identified on a site-specific basis and involve a two-part analysis. First, a determination is made whether a given requirement is applicable. Second, if it is not applicable, a determination is made whether it is both relevant and appropriate. When this analysis results in a determination that a requirement is both relevant and appropriate, such a requirement must be complied with to the same degree as if it were applicable. There are three categories of ARARs: Chemical-Specific, Location-Specific, and Action-Specific.

6.3.3 According to the NCP, Chemical-Specific ARARs are usually health or risk-based standards that establish the acceptable amount of chemical concentration that may remain in, or be discharged to, the ambient environment. Location-Specific ARARs are generally restrictions placed on the concentration of a hazardous substance 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 remedial activities with respect to hazardous wastes, or requirements to conduct certain actions to address particular circumstances at a site. These ARARs may specify particular performance levels, actions, or technologies to be used to manage hazardous substances, pollutants, or contaminants.

6.3.4 Non-promulgated advisories or guidance documents issued by the Federal or State governments do not have the status of potential ARARs. However, these "to be considered" (TBC) criteria may be used in determining the necessary level of cleanup for human safety and protection of the environment. In addition, there are specific requirements that must be followed when conducting OE Response Actions. Potential ARARs and TBCs for the Bravo EE/CA are discussed in the following paragraphs.

6.4 DISCUSSION OF POTENTIAL ARARS/TBCS

6.4.1 Chemical-Specific ARARs

There are no applicable Chemical-Specific ARARs.

6.4.2 Location-Specific ARARs

Potential Location-Specific ARARs include the Archeological Resources Protection Act of 1979 (43 CFR Part 7); the Endangered Species Act of 1973, as amended (16 USC 1531); the Protection of Historic Resources (36 CFR 800); and other relevant ARARs. These ARARs are presented in Table 6-1.

6.4.3 Action-Specific ARARs.

The National Environmental Policy Act (NEPA), as implemented by Army Regulation (AR) 200-2, Environmental Effects of Army Actions, is applicable to future land use alternatives that involve developing the site for commercial or residential purposes which could result in environmental impacts. This and other ARARs are presented in Table 6-1.

6.4.4 Specific Requirements and TBCs

OE response actions will be executed in compliance with the Military Munitions Rule (40 CFR Part 260 et al); the OE requirements of Ammunition and Explosives Safety Standards (DoD 6055.9-STD); Ammunition and Explosives Safety Standards (AR 385-64); and Explosives Safety Policy for Real Property Containing Conventional Ordnance and Explosives, and other applicable OE publications.

6.5 INTENDED LAND USE

If the Bravo Area is found suitable for transfer after the recommended response action alternatives have been implemented, it is intended that the majority of the property will be transferred to the JPA. Small segments of the property will be transferred to the Alabama Department of Transportation (ALDOT) and the United States Fish and Wildlife Service (FWS). According to the approved land use planning information available to date, the Bravo Area has multiple designated future land uses including: Active Recreation, Passive Recreation, Cultural, Retail, Mixed Business Use, and Development Reserve (see 4.2.2 Projected Future Land Use and the Specification of Risk Assessment Sectors). The majority of the Bravo Area is designated as Passive Recreation. The southwestern corner of the Bravo Area is designated as Cultural. The Eastern Bypass is designed as a north-south area that passes through the Bravo Area on the western side. Along the northern border of the Bravo Area, several different land uses exist including Retail, Mixed Business Use, and Development Reserve. Along the southern border, Passive Recreation is the designated land use. There is a propsed residential land use for certain area under consideration. Based on this propsed land use, two risk analyses were performed for Sector M3-Remainder Area-PR and included in this EE/CA.

Table 6-1
List of Potential Applicable or Relevant and Appropriate Requirements To Be Considered

ARAR/TBC	Citation	Description	Comments
Chemical-Specific			
None required			
Location-Specific			
Archeological Resources Protection Act of 1979	43 CFR Part 7 36 CFR Part 296 32 CFR Part 229 18 CFR Part 1312	Protection of archeological resources on public land.	Potential ARAR for site activities which could impact an archeological resource area.
American Indian Religious Freedom Act	42 USC 1996	Requires consultation with Native Americans about traditional religious and cultural sites on Federal Lands to protect and provide access to such sites.	Potential ARAR for site activities which could impact a cultural site.
Clean Water Act, Section 404 (B)(1) Guidelines	40 CFR 230.10	Establishes criteria for evaluating impacts to waters of the US and sets factors for considering mitigation measures. Outlines the requirements for discharges of dredged or fill material into waters of the United States	Potential ARAR for sampling work, placement of equipment, any site removal or backfilling work within tidal areas and wetlands, and for dredge and fill activities
Endangered Species Act of 1973, as amended	16 USC 1531	Provides for the consideration of the impacts on endangered and threatened species and their critical habitats	Potential ARAR for activities in areas where there is considered to be current populations of endangered or threatened species of flora and fauna
Fish and Wildlife Conservation Act	16 USC 2901 50 CFR 83	Protects fish and wildlife when federal actions result in modification of a waterbody; requires consultation with U.S. Fish and Wildlife Service and state wildlife agencies to mitigate losses	Potential ARAR if the work activity is within a conservation area
Protection of Wetlands	33 CFR 320 et. Executive Order 11990	Requires consideration of impacts to wetlands in order to minimize their destruction, loss or degradation and to preserve/enhance wetland values	Potential ARAR for sampling work, placement of equipment and any site removal or backfilling work within tidal areas and wetlands
Protection of Historic Resources	36 CFR 800	Requires consideration of impacts to historic and cultural resources	Potential ARAR for site activities which could impact historic and cultural resources
Preservation of Historical and Archeological Data	16 USC 469a 36 CFR 66	Requires the preservation of archeological and historical data from destruction or becoming lost	Potential ARAR for site activities which could impact historic and archeological data
Native American Graves Protection and Repatriation Act	43 CFR 10	Consultation with Native Americans must occur before excavation of ancestral remains and other items commences	Potential ARAR for site activities which could impact Native American graves
Act for the Preservation of American Antiquities	16 CFR 251.50-64 43 CFR 3	A permit must be obtained before excavation of antiquities occurs	Potential ARAR for site activities which could impact American antiquities

Table 6-1 (continued)
List of Potential Applicable or Relevant and Appropriate Requirements To Be Considered

ARAR/TBC	Citation	Description	Comments
Wilderness Act of 1964	PL 88-577 16 USC 1131-1136	Preserves and protects the wilderness areas	Potential ARAR for site activities which could impact wilderness areas
Migratory Bird Treaty Act of 1918	16 USC 703-712	Prevents the disturbance of birds, nests, and eggs	Potential ARAR for site activities which could impact birds, their nests, and their eggs
Protection and Enhancement of Sacred Indian Sites, 1976	Executive Order 13007	Protects the sacred Native American sites	Potential ARAR for site activities which could impact sacred Indian sites
Action-Specific			
National Ambient Air Quality Standards	40 CFR 50	Air quality standards for ambient air	Potential ARAR for any on-site detonation of OE
Particulate Emission Controls	40 CFR 50.6	Specifies limitations for the emission of particulate matter	Potential ARAR for on-site soil disturbances which generate dust
Environmental Effects of Army Actions	AR 200-2 (NEPA-40 CFR 1500-1508)	States that the need for an Environmental Assessment or Environmental Impact Statement must be evaluated if there is a potential for adverse impacts to the environment	Potential ARAR for site activities which could require NEPA actions
Occupational Safety and Health Act	29 USC 651-667	States that safety and health standards will be enforced during OE removal activities	Potential ARAR for site activities which may involve OE removal activities
Resource Conservation and Recovery Act (RCRA) Military Munition Rule	62 CFR 6654	Specifies the identification and management of residual munitions	Potential ARAR for site activities which may involve residual munitions
Safety and Health Requirements on Conventional Ordnance and Explosives Act	ER 385-1-95	Specifies the responsibilities in regards to safety and health for OE response actions	Potential ARAR for site activities which may involve OE response actions
To Be Considered (TBC) Criteria			
RCRA Management of Military Munitions	Military Munitions Rule (40 CFR 264 and 26 subpart EE; 266 subpart M)	Amendments to hazardous waste identification and management rules for military munitions and definition of explosive emergencies	Potential TBC for removal and management of unexploded ordnance pursuant to RCRA
Department of the Army Ammunition and Explosive Safety Standards	AR 385-64	Requires army standards to be implemented for locating, handling, and disposing of munitions	Potential TBC for site activities which may involve munitions
Department of Defense Ordnance Safety Standards	DoD 6055.9-STD	Requires that during detection, removal, and disposal of OE there must be specialized personnel attending	Potential TBC for site activities which may involve detection, removal, and disposal of OE
ESSs for Removal of Ordnance and Explosives from Real Property	DDESB Memorandum	Specifies requirements for explosive safety submissions for removal actions	Potential TBC for site activities which may involve explosive safety submissions
Explosives Safety Policy for Real Property containing Conventional Ordnance and Explosives	Letter, Department of the Army	Specifies the policy for explosives safety controls on real property containing OE	Potential TBC for site activities which may require explosive safety controls

THIS PAGE INTENTIONALLY LEFT BLANK.

7.0 IDENTIFICATION AND ANALYSIS OF RESPONSE ACTION ALTERNATIVES

Six response action alternatives have been identified as "reasonable measures" for protection of the public and the environment from exposure to OE. This chapter presents a description and evaluation of each alternative considered for the Bravo Area at Fort McClellan. Each sector-specific chapter (Chapter 8.0 through 24.0) presents a comparative analysis of the alternatives, resulting in a relative ranking of alternatives for each sector. The alternatives developed for the Bravo Area EE/CA include:

- Alternative 1–No Further Action
- Alternative 2–Area-Specific Land Use Controls
- Alternative 3–Construction Support
- Alternative 4–Surface Clearance
- Alternative 5–Clearance to One Foot
- Alternative 6–Clearance to Depth

7.0.1 These alternatives are designed to focus on the risk assumed to be present based on the information derived from archives and the additional investigations completed as part of this EE/CA effort. However, the potential exists that some residual OE contamination could remain following the implementation of the removal alternatives. For removal alternatives (except the clearance to depth alternative), residual contamination may potentially exist below the depth of clearance selected for the alternative. In addition, even though state of the art technology is employed in the detection and removal of OE, it is not possible to ensure that 100 percent of all OE within the boundary of the investigation area are removed during the removal action. **Any residual risk from remaining OE will be managed through a community outreach program and a deed notice. The community outreach program will provide the general public awareness of the ordnance history and the potential dangers posed by any residual OE at Fort McClellan. The inclusion of a deed notice in all property transfer documents informs future property owners of the history of OE use and provides notification procedures in the event an OE item is discovered.**

7.1 DESCRIPTION OF ALTERNATIVES

7.1.1 Alternative 1 – No Further Action

The No Further Action alternative requires No Further Action at the site and therefore, depending on results of the site Characterization may leave undiscovered OE in the environment that could pose a potential risk to the public. This alternative does not impose any land use controls (i.e., as described below for Alternative 2). This alternative was evaluated for each sector of the Bravo Area as a baseline for comparing other alternatives.

7.1.2 Alternative 2 – Area-Specific Land Use Controls

This alternative focuses on minimizing or controlling potential exposures to the public or the environment that may be associated with OE in the study area using area-specific land use controls. These land use controls may consist of one or more institutional controls or engineering controls tailored to the study area, including a deed restriction that prohibits digging in the area without construction support by UXO-qualified personnel, signage, and/or periodic inspection and maintenance activities. Selection of this alternative will require compliance with the LUCAP, a joint agreement between the EPA, ADEM, the DA for FMC, and the Anniston-Calhoun County Fort McClellan Development Joint Powers Authority (JPA). The LUCAP defines the process for determining when land use controls are needed, how land use control plans will be developed, and specifies responsibilities for monitoring and enforcement.

7.1.3 Alternative 3 – Construction Support

Alternative 3 includes providing surface and subsurface clearance of OE in designated areas where construction activities are planned. UXO-qualified personnel, using metal detection instruments, will detect OE items that may exist on or below the ground surface in areas where intrusive building activities are planned. Any OE located during this action will be inspected to ensure its stability and disposed of in accordance with a previously approved work plan.

7.1.4 Alternative 4 – Surface Clearance

This alternative involves removal of surface OE from the site. The area is divided into investigation grids and a visual search (aided by hand-held metal detection instruments) is conducted by UXO personnel walking through each grid, scanning the surface for OE. Detected items will be investigated to identify them as OE, OE Scrap, or Non-OE Scrap. Items known or suspected to be OE will be marked with a pin flag for later disposition. OE items suspected to be UXO will be destroyed. Unfuzed UXO items will be removed and consolidated within the investigation grid and then destroyed. OE Scrap will be removed, inspected, certified safe, and disposed in an appropriate manner. Land surveying and brush clearing operations will be a necessary component of this alternative. This alternative will include a deed restriction that prohibits digging in the study area without construction support by UXO-qualified personnel.

7.1.5 Alternative 5 – Clearance to One Foot

Alternative 5 will include the surface and subsurface clearance of OE items to a depth of one foot. The depth of one-foot was selected based on site-specific information, future land use, type of ordnance items found in the vicinity and that may be present within the study area, and typical penetration depths for the types of OE items that may be present. Implementation of this alternative will require land surveying and brush clearing operations to prepare the site. Where technically feasible, suitably sensitive detection instruments will be used to survey the study area and locate subsurface anomalies. These anomalies will be subsequently investigated down to 12 inches. After identification, the item will be disposed of as scrap or OE in accordance with a previously approved OE operations work plan.

In some areas this alternative will include a deed restriction that prohibits digging in the study area without construction support by UXO-qualified personnel.

7.1.6 Alternative 6 – Clearance to Depth

This alternative includes the surface and subsurface clearance of OE items to a depth corresponding to the maximum depth of OE encountered in each sector. Under this alternative, investigation (i.e., excavation) of an anomaly (i.e., suspect OE item) will continue until the source of the anomaly is found, or until it is determined that no OE item is present. This alternative differs from Alternative 5 in that the depth of clearance is not limited to one foot. Implementation of this alternative will require land surveying and brush clearing operations.

7.1.6.1 After the sector is cleared of surface contamination, a subsurface investigation will be conducted. Due to the requirement to detect items deeper than one foot, this alternative will be performed using sensitive instruments capable of detecting anomalies at greater depths. Using a suitably sensitive detection system, the entire study area will be surveyed to locate potential OE items. The anomalies will then be investigated to identify them as OE, OE Scrap, or Non-OE Scrap (metallic scrap). After identification, the items will be disposed of as scrap or OE in accordance with the previously approved OE operations work plan.

7.2 EVALUATION OF ALTERNATIVES

This chapter presents a general evaluation of each alternative by comparing them to three main criteria: 1) Effectiveness, 2) Implementability, and 3) Cost. The effectiveness criterion considers overall protection to human health and the environment; compliance with ARARs or other requirements; long-term effectiveness and permanence; and short-term effectiveness. The implementability criterion considers technical feasibility; availability of services and materials; administrative feasibility; regulatory acceptance; and community acceptance. Cost is evaluated for each alternative on sector-specific basis. Appendix H contains detailed cost estimates and pertinent assumptions. These criteria are more fully described in the following paragraphs.

7.2.1 Effectiveness

- Overall protection to human health and the environment: Evaluates the effectiveness of an alternative and its ability to meet the objective within the scope of the proposed alternative. It is considered in terms of protectiveness of public health and the environment.
- Compliance with ARARs or other requirements: Serves as a final check to assess whether each alternative meets all the potential Federal and State ARARs as identified in the EE/CA process. ARARs are "those cleanup standards, standards of control and other substantive environmental protection requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site" (40 CFR 300.5). Selection of an ARAR is dependent upon the hazardous substances present at the site, site characteristics and location and action selected for remediation. Chemical-Specific ARARs are health or risk-based concentration limits for specific hazardous substances. Location-Specific ARARs address circumstances such as the presence of endangered species on the site or location of the site in a 100-year floodplain. Action-Specific ARARs control or restrict specific types of actions selected as alternatives for site cleanup. No Chemical-Specific ARARs exist for remediation of sites containing ordnance and explosives.

- Long-term effectiveness and permanence: Addresses the effectiveness of an alternative in terms of the risk remaining at the site after the response action objectives have been met. Generally considers the magnitude of risk remaining following the implementation of the alternative and the adequacy and reliability of the controls used to manage residual risk remaining at the site.
- Short-term effectiveness: Evaluates the potential effects on human health and the environment during the implementation of the alternative and considers the potential risk to the community and workers implementing the response action alternatives, and the potential for adverse impacts to the environment.

7.2.2 Implementability

- Technical feasibility: Addresses the practicality of completing the alternative considering physical constraints.
- Administrative feasibility: Addresses the activities required to coordinate with multiple offices and agencies (e.g., obtaining permits for off-site activities, right-of-way or alignment agreements, compliance with statutory limits, and enforcement of land use controls) and private property owners.
- Availability of services and materials: Addresses the availability of personnel, equipment and materials required to implement the alternative.
- Regulatory acceptance: Addresses the concerns and issues that the EPA, the State of Alabama and local government agencies may have regarding the alternative. Regulatory acceptance will be a factor in the final selection of the alternative(s) presented in the EE/CA Action Memorandum.
- Community acceptance: Addresses the concerns and issues the public and other stakeholders may have regarding the alternative. Community acceptance will be a factor in the final selection of the alternative(s) presented in the EE/CA Action Memorandum.

7.2.3 Cost

Costs for implementing individual alternatives are provided in each sector-specific chapter (8.0 through 24.0) and detailed cost estimates and pertinent assumptions are included in Appendix G.

7.3 EFFECTIVENESS

7.3.1 Alternative 1–No Further Action

If there is potential for OE to be present, Alternative 1 provides no reduction in the risk associated with OE exposure and no protection of the environment. Since OE exposure is dependent on the type of land use, the risk of future OE exposure can be expected to change (increase or decrease) if the land use changes. Since No Further Action is taken, there are no impacts to human health or the environment during implementation. No location-specific, action-specific, or chemical-specific ARAR is applicable, as No Further Action is taken.

7.3.2 Alternative 2–Area-Specific Land Use Controls

Area-Specific Land Use Controls will not include the removal or destruction of OE, therefore, it cannot be seen as providing absolute protection to public health or the environment. This alternative focuses on minimizing or controlling potential exposures to the public using land use controls. These controls may include a deed restriction that prohibits digging without UXO-qualified personnel, signage, and/or periodic maintenance activities. The threat to public health and the environment from OE exposure will be reduced only to the extent that the controls are initially effective and remain so. The long term effectiveness or permanence of land use controls will diminish if the posted warning signs are removed or allowed to deteriorate. To achieve long term effectiveness, continued maintenance of the warning signs will be necessary.

7.3.2.1 Safety concerns exist during implementation. These concerns are primarily due to the potential exposure of workers to OE during sign installations. This potential exposure will be reduced by following OE avoidance procedures (i.e., signs will not be installed in an area of ground where a subsurface anomaly has been detected).

7.3.2.2 Action-Specific ARARs and Location-Specific ARARs applicable to this alternative will be determined based on which component of this alternative is implemented. Area-Specific land use controls may consist of several different institutional and/or engineering controls. Applicable Action-Specific ARARs and Location-Specific ARARs will be followed. There are no Chemical-Specific ARARs requiring removal of OE to regulatory levels.

7.3.3 Alternative 3–Construction Support

Alternative 3, Construction Support, will be effective in removal of OE items most likely to be encountered by construction workers and will reduce the risk of an accidental encounter with OE within construction footprint areas. Overall protection of the public and the environment will be strongly related to the quantity of OE that is on or near the surface. In footprint areas where surface OE is more common, this alternative will greatly reduce the level of risk. Therefore, this alternative should be reliable, but it will be much less reliable in areas outside the footprints. Effectiveness to protect the public in these areas will primarily depend on the implementation and continued maintenance of the education and sign posting requirements of this alternative. The deed notice to be filed with property transfer documents will also help to increase the effectiveness by informing future property owners of the OE history and what notification actions to take in the event an OE item is discovered following the implementation of this alternative.

7.3.3.1 Short-term effectiveness is dependent upon the potential for UXO workers to be exposed to OE during implementation of the alternative. Adherence to safety procedures and associated Site Safety and Health Plans will significantly limit the risk to UXO workers. Implementation of this alternative should have no short-term risk to the affected community and minimal adverse environmental impacts.

7.3.3.2 Action-Specific ARARs potentially applicable to this alternative include National Ambient Air Quality Standards and the Occupational Safety and Health Act. During construction, any OE items found will be removed by UXO-qualified personnel. Location-

Specific ARARs potentially applicable to this alternative include the Archaeological Resources Protection Act of 1979, Endangered Species Act of 1973, Fish and Wildlife Conservation Act, Protection of Wetlands, Protection of Historic Resources, and Preservation of Historical and Archaeological Data. There are no Chemical-Specific ARARs requiring removal of OE to regulatory levels. TBC criteria applicable to this alternative include Resource Conservation and Recovery Act (RCRA) Management of Military Munitions, Department of the Army Ammunition and Explosive Safety Standards, ESSs for Removal of Ordnance and Explosives from Real Property, and Explosives Safety Policy for Real Property containing Conventional Ordnance and Explosives.

7.3.4 Alternative 4–Surface Clearance

Alternative 4 will be effective in the removal of OE items located on the surface, and therefore, will greatly reduce the risk of an accidental encounter with OE. However, OE that may be present in the subsurface will not be removed. Thus, this alternative will provide only limited protection against intrusive (i.e., digging, excavation) activities. The overall extent to which surface clearance will increase overall protection of public health and the environment will be directly related to the quantity of OE that is presently located on the surface. The deed notice to be filed with property transfer documents will also help to increase the overall effectiveness by informing future property owners of the OE history and what notification actions to take in the event an OE item is discovered following the implementation of this alternative.

7.3.4.1 Short-term effectiveness will be dependent upon the potential for UXO workers to be exposed to OE during implementation of the alternative. Adherence to safety procedures and Site Safety and Health Plans will significantly limit the risk to UXO workers. In the event that OE is discovered and detonation-in-place is the preferred disposal option, the surrounding area may be affected by noise and ground shock. Environmental impacts from clearance should be minimal.

7.3.4.2 Action-Specific ARARs potentially applicable to this alternative include National Ambient Air Quality Standards and the Occupational Safety and Health Act. During implementation of the alternative, OE items located on the surface within the specified area will be removed by UXO-qualified personnel. Location-Specific ARARs potentially applicable to this alternative include the Archaeological Resources Protection Act of 1979, Endangered Species Act of 1973, Fish and Wildlife Conservation Act, Protection of Wetlands, Protection of Historic Resources, and Preservation of Historical and Archaeological Data. There are no Chemical-Specific ARARs requiring removal of OE to regulatory levels. TBC criteria applicable to this alternative include RCRA Management of Military Munitions, Department of the Army Ammunition and Explosive Safety Standards, ESSs for Removal of Ordnance and Explosives from Real Property, and Explosives Safety Policy for Real Property containing Conventional Ordnance and Explosives.

7.3.5 Alternative 5–Clearance to One Foot Depth

Alternative 5, Clearance to One Foot Depth, will significantly reduce the potential for direct contact with OE. It will be an effective and permanent solution for reducing risk of exposure. The risk of near-surface OE being moved to the surface by freeze/thaw cycles or erosion should be eliminated since OE would be removed down to a depth of 12 inches (frost depth is 6 inches

at Fort McClellan). The deed notice to be filed with property transfer documents will also help to increase the overall effectiveness by informing future property owners of the OE history and what notification actions to take in the event an OE item is discovered following the implementation of this alternative.

7.3.5.1 Short-term effectiveness will be dependent upon the potential for UXO workers to be exposed to OE during implementation of this alternative. Adherence to safety procedures and Site Safety and Health Plans will significantly limit the risk to UXO workers. The short-term risk to the public resulting from implementation is minimal. In the event that OE is discovered and detonation-in-place is the preferred disposal option, the surrounding area may be affected by noise and ground shock. Environmental impacts from implementing this alternative should be minimal.

7.3.5.2 Action-Specific ARARs potentially applicable to this alternative include National Ambient Air Quality Standards and the Occupational Safety and Health Act. During implementation of the alternative, any OE items located within one foot below ground surface, within the specified area will be removed by UXO-qualified personnel. Location-Specific ARARs potentially applicable to this alternative include the Archaeological Resources Protection Act of 1979, Endangered Species Act of 1973, Fish and Wildlife Conservation Act, Protection of Wetlands, Protection of Historic Resources, and Preservation of Historical and Archaeological Data. There are no Chemical-Specific ARARs requiring removal of OE to regulatory levels. TBC criteria applicable to this alternative include RCRA Management of Military Munitions, Department of the Army Ammunition and Explosive Safety Standards, ESSs for Removal of Ordnance and Explosives from Real Property, and Explosives Safety Policy for Real Property containing Conventional Ordnance and Explosives.

7.3.6 Alternative 6–Clearance to Depth

Alternative 6, Clearance to Depth, will significantly reduce the potential for direct contact with OE, and will be an effective and permanent solution for reducing risk of exposure. The risk associated with OE being moved to the surface by freeze/thaw cycles or erosion will be significantly reduced since all detectable subsurface OE will be removed.

7.3.6.1 Short-term effectiveness will depend on the potential for UXO workers to be exposed to OE during implementation. Adherence to safety procedures and Site Safety and Health Plans will significantly limit the risk to UXO workers. The short-term risk to the public resulting from implementation will be minimal. In the event that OE is discovered and detonation-in-place is the preferred disposal option, the area may be affected by noise and ground shock. Environmental impacts from implementing this alternative should be minimal.

7.3.6.2 Action-Specific ARARs potentially applicable to this alternative include National Ambient Air Quality Standards and the Occupational Safety and Health Act. During implementation of this alternative, any OE items detected within the specified area will be removed by UXO-qualified personnel. Location-Specific ARARs potentially applicable to this alternative include the Archaeological Resources Protection Act of 1979, Endangered Species Act of 1973, Fish and Wildlife Conservation Act, Protection of Wetlands, Protection of Historic Resources, and Preservation of Historical and Archaeological Data. There are no Chemical-specific ARARs requiring removal of OE to regulatory levels. TBC criteria applicable to this

alternative include RCRA Management of Military Munitions, Department of the Army Ammunition and Explosive Safety Standards, Explosives Safety Submissions (ESS) for Removal of Ordnance and Explosives from Real Property, and Explosives Safety Policy for Real Property containing Conventional Ordnance and Explosives.

7.4 IMPLEMENTABILITY

7.4.1 Alternative 1–No Further Action

Technically, this alternative will be easy to implement, as there are no investigations or risk reduction actions being taken. Administratively however, implementation of this alternative will be more difficult. An Environmental Safety Submission (ESS) document must be prepared in accordance with DOD 6055.9- STD, Ammunition and Explosives Safety Standards, and approved by the Department of Defense Explosives Safety Board (DDESB). Furthermore, since this alternative takes No Further Action to remove or reduce the risk of exposure to OE, there may be a strong reluctance on the part of EPA, ADEM, the local government and/or community to accept this approach, particularly in any areas where there is known or suspected presence of OE.

7.4.2 Alternative 2–Area-Specific Land Use Controls

Technically, this alternative will be relatively easy to implement, as it will not require any special materials or equipment. It will require readily available services and materials to install warning signs at selected locations. UXO personnel will be required to clear the area prior to installation of signs and ensure that proper safety precautions are implemented to prevent untrained personnel from handling OE. Otherwise no special services or operators are required. Administratively however, implementation of this alternative will be more difficult. An ESS document must be prepared in accordance with DOD 6055.9- STD, Ammunition and Explosives Safety Standards, and approved by the DDESB.

7.4.2.1 This alternative will also require compliance with the LUCAP which establishes the process for determining how land use control plans will be developed and specifies responsibilities for monitoring and enforcement. It will require coordination between EPA, ADEM, the DA for FMC, and JPA, per the LUCAP.

7.4.2.2 Furthermore, since this alternative takes No Further Action to remove OE, there may be some reluctance on the part of EPA, ADEM, the local government and/or community to accept this approach, particularly in any areas where there is known or suspected presence of OE. A positive community relations program will be warranted to support implementation of this alternative.

7.4.3 Alternative 3–Construction Support

Alternative 3, Construction Support, will be easy to implement technically, but less so administratively. Technically, the alternative requires sign posting. It will require equipment, skills, personnel and technologies associated with land clearing and OE detection, excavation, and disposal. UXO personnel will be required to clear the construction area prior to initiation of

work activities and ensure that proper safety precautions are implemented to prevent untrained personnel from handling OE. Personnel, equipment and materials are readily available.

7.4.3.1 Administratively, activities associated with this alternative will need to be coordinated with construction contractors. Permits and/or approvals may be required if it becomes necessary to transport OE offsite for disposal. A Construction Support Work Plan will be required. An ESS document prepared in accordance with DOD 6055.9- STD, Ammunition and Explosives Safety Standards, and approved by the DDESB will be required. Because of the land use control components (sign posting), selection of this alternative will also require compliance with the LUCAP, which establishes the process for determining how land use control plans will be developed and specifies responsibilities for monitoring and enforcement. It will require coordination between EPA, ADEM, the U.S. Department of the Army for Fort McClellan, and JPA, per the LUCAP. Furthermore, since this alternative does little to reduce the potential risk in the non-construction footprint areas, EPA, ADEM, the local government, and the community may be reluctant to accept this alternative, warranting a positive community relations program for support.

7.4.4 Alternative 4–Surface Clearance

Alternative 4, Surface Clearance, will be technically and administratively feasible. Technically, efforts associated with implementing this alternative will vary based on the topography and vegetative cover. The sign posting is an integral part of this alternative. Implementation of this alternative will require equipment, skills, personnel and technologies associated with land clearing and OE detection, excavation, and disposal. UXO-qualified personnel must be used during implementation of all aspects of this alternative. Proper safety precautions must be implemented to prevent untrained individuals from handling OE.

7.4.4.1 Administratively, selection of this alternative will require an approved work plan that describes in detail the procedures, equipment, and personnel required to implement this removal action. In addition, an ESS document prepared in accordance with DOD 6055.9- STD, Ammunition and Explosives Safety Standards, and approved by DDESB will be required.

7.4.4.2 Due to the land use control components (sign posting), selection of this alternative will also require compliance with the LUCAP which establishes the process for determining how land use control plans will be developed and specifies responsibilities for monitoring and enforcement. It will require coordination between EPA, ADEM, the DA for FMC, and JPA, per the LUCAP.

7.4.4.3 This alternative reduces the public's risk of accidental exposure to OE; as a result, EPA, ADEM, the local government and the community may be more willing to accept this alternative. However, concerns may still be expressed since this alternative does not remove subsurface OE items and therefore, does not decrease the risk resulting from intrusive activities. A positive community relations program may be warranted if this alternative is selected for implementation.

7.4.5 Alternative 5–Clearance to One Foot Depth

Alternative 5, Clearance to One Foot Depth, will be technically and administratively feasible. Technically, efforts associated with implementing this alternative will vary based on the topography and vegetative cover, and will require equipment, skills, personnel and technologies associated with land clearing and OE detection, excavation, and disposal. UXO-qualified personnel must be used during implementation of all aspects of this alternative. Proper safety precautions must be implemented to prevent untrained individuals from handling OE.

7.4.5.1 An approved work plan that describes in detail, the procedures, equipment, and personnel required to implement this removal action will be required. An ESS document prepared in accordance with DOD 6055.9- STD, Ammunition and Explosives Safety Standards, and approved by the DDESB will also be required.

7.4.5.2 It is anticipated that EPA, ADEM, the local government, and the local community will be willing to accept this alternative since it is designed to remove both surface and subsurface OE. However, some individuals may be concerned that the alternative will disrupt routine activities in the area and potentially destroy property and/or habitat by excavation and detonation-in-place. A positive community relations program may be warranted to support implementation of this alternative to ensure the public that appropriate measures will be taken to minimize inconveniences and prevent damage to local property or habitat.

7.4.6 Alternative 6–Clearance to Depth

Alternative 6, Clearance to Depth, will be technically and administratively feasible. Technically, efforts associated with implementing this alternative will vary based on the terrain and vegetative cover, and will require equipment, skills, personnel and technologies associated with land clearing and OE detection, excavation, and disposal. UXO-qualified personnel must be used during implementation of all aspects of this alternative. Proper safety precautions must be implemented to prevent untrained individuals from handling OE.

7.4.6.1 Administratively, an approved work plan that describes in detail, the procedures, equipment, and personnel required to implement this removal action will be required. An ESS document prepared in accordance with DOD 6055.9- STD, Ammunition and Explosives Safety Standards, and approved by the DDESB will also be required.

7.4.6.2 It is anticipated that EPA, ADEM, the local government, and the local community will be willing to accept this alternative since it is designed to remove both surface and subsurface OE. However, some individuals may be concerned that the alternative will disrupt routine activities in the area and potentially destroy property and/or habitat by excavation and detonation-in-place. A positive community relations program may be warranted to support implementation of this alternative to ensure the public that appropriate measures will be taken to minimize inconveniences and prevent damage to local property or habitat.

7.5 COST

7.5.1 Alternative 1–No Further Action

The cost to implement Alternative 1 includes the effort associated with the preparation of the ESS and should be relatively independent of the sector to which it is applied. The level of effort covers the initial preparation and submittal of a draft and final ESS document. Chapters 8.0 through 24.0 provide cost estimates for each individual sector.

7.5.2 Alternative 2–Area-Specific Land Use Controls

The estimate for Alternative 2, Area-Specific Land Use Controls, includes the cost to prepare the ESS, perform periodic reviews and site inspections, and is dependent upon the size, material, number, and spacing of signs. Chapters 8.0 through 24.0 provide cost estimates for each individual sectors.

7.5.3 Alternative 3–Construction Support

The estimated cost to provide construction support will depend on the nature and duration of construction activities. The estimate includes the cost for management; preparation of a Construction Support Work Plan and ESS; UXO construction support (will vary depending on the total acreage and future land use); and posting of signs. Cost estimates for individual sectors are provided in Chapters 8.0 through 24.0.

7.5.4 Alternative 4–Surface Clearance

The estimated cost to perform Alternative 4 varies with surface OE density, topography, coverage area, vegetative cover, and site access. The cost to implement this alternative is based on the estimated density of surface OE, which is based on the information developed during this EE/CA investigation and previous investigations conducted in the Bravo Area. The estimate includes the cost for management; preparation of the Work Plan, ESS, and Removal Report; site preparation; OE detection, excavation, and disposal; OE Scrap disposal; and posting of signs. If engineering controls are employed for sectors near inhabited areas, the costs for implementing this alternative may increase. Chapters 8.0 through 24.0 provide cost estimates for each individual sectors.

7.5.5 Alternative 5–Clearance to One Foot Depth

The estimated cost to perform Alternative 5 varies with OE density, topography, coverage area, vegetative cover, and site access. The cost to implement this alternative is based on the estimated density of surface and subsurface OE, which is based on the information developed during this EE/CA investigation as well as previous investigations conducted in the Bravo Area. The estimate includes the cost for management, preparation of the Work Plan, ESS and the Removal Report; site preparation; OE detection, excavation, and disposal; and OE Scrap disposal. If engineering controls are employed for sectors near inhabited areas, the costs for implementing this alternative may increase. Costs for highly contaminated areas are not part of these estimates

and may need to be addressed under mechanical removal. Cost estimates for each individual sector is provided in Chapters 8.0 through 24.0.

7.5.6 Alternative 6–Clearance to Depth

The estimated cost to perform Alternative 6 varies with OE density, topography, coverage area, vegetative cover, and site access. The cost to implement this alternative is based on the estimated density of surface and subsurface OE, which is based on the information developed during this EE/CA investigation and from previous investigations conducted in the Bravo Area. The estimate includes the cost for management; preparation of the Work Plan, ESS and the Removal Report; site preparation; OE detection, excavation, and disposal; and OE Scrap disposal. If engineering controls are employed for sectors near inhabited areas, the costs for implementing this alternative may increase. Costs for highly contaminated areas are not part of these estimates and may need to be addressed under mechanical removal. Chapters 8.0 through 24.0 provide cost estimates for each individual sectors.

8.0 A1-RECONNAISSANCE AREA-D

8.1 DESCRIPTION AND HISTORY

This sector consists of approximately 160 acres along the northern border of the Bravo Area. A 27-acre portion of the A1-Reconnaissance Area-D was originally included in the Field Reconnaissance of Areas 247Q (A3), A1, and A2, but has now been added to the Bravo EE/CA. This portion was known as the A1 area and is the triangular piece north of Halifax Avenue and the 1600 Area Motor Pool. Two expended 75mm shrapnel rounds were found during the site reconnaissance of the A1 area. Appendix C contains figures from the field reconnaissance. The Former A-1 Area was combined with areas already in the Bravo Area and renamed the A1-Reconnaissance Area-D. This sector is located in the area where portions of an impact area and a small arms training range were historically located. The southwestern edge of the WWI Artillery Range (OA-29/39) and the west side of the firing fan of Combat Range #1 (OA-43) were historically located within this sector. Combat Range #1 was constructed during the Inter-War period and used for 37mm anti-tank guns and 75mm artillery guns. The Washington Rifle Range (OA-44), also referred to as Range 18, was constructed during WWII and was continuously used as a rifle range. Range 16 was also a small part of this sector. The firing fans of the three small arms ranges also extend into this area. They are Range 12 (OA-48), Range 19 (OA-50), and Old Range 12 (OA-55). Range 12 was built after WWII and was used as a competitive pistol range. Range 19 was built during the Vietnam War as a 10m Machine Gun Range and was later used as a Pistol Qualification Range. Old Range 12 was built during WWII as a landscape range and was abandoned by 1967. By 1958, the range was referred to as Range 12, Rifle Field Firing. Typical ordnance items associated with the training activities that historically occurred in this area include 37mm projectiles, 60mm projectiles, and 75mm projectiles. The projected land use for this sector is Mixed Business Use (i.e., development).

8.2 INVESTIGATION RESULTS

During the site characterization of Bravo, 15 grids in this OE Risk Assessment Sector were geophysically mapped and 4 of these grids were then intrusively investigated. Delineation transects were a second investigation method used specifically to characterize suspected areas of high likelihood of containing OE in this OE Risk Assessment Sector. The following delineation transects were placed in this OE Risk Assessment Sector: part of M42H001, part of M42H004, part of M42H006, part of M42H008, and M42H010. A total of 7.76 acres in grids and 27.4 acres in transects were geophysically mapped. A total of 1.74 acres were intrusively investigated in grids.

8.2.1 A total of 9 UXO items were found on the surface and at depths up to 15 inches during field activities in this OE Risk Assessment Sector. Approximately 42 OE Scrap items with some additional indeterminate amounts were also found on the surface and at depths up to 36 inches within this OE Risk Assessment Sector. Table 8-1 contains a list of OE and OE Scrap items found within this OE Risk Assessment Sector. Figure B-2 in Appendix B presents an overview figure of this OE Risk Assessment Sector within the Bravo Area and Appendix F contains a list of all items from the database found within this OE Risk Assessment Sector.

Table 8-1
List of OE and OE Scrap Found in A1-Reconnaisance Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
UXO Items:					
PROJECTILE, 3.8in SHRAPNEL, MKI	1	15	UXO	27	2
PROJECTILE, 75mm SHRAPNEL, MKI, w/FUZE, POWDER TRAIN TIME, M1907, FUZE FUNCTIONED	1	3	UXO	27	37
PROJECTILE, 75mm SHRAPNEL, MKI	1	1	UXO	27	46
PROJECTILE, 37mm, PRACTICE, MKII AI w/ LE CHARGE	1	2	UXO	27	54
MORTAR, 3in STOKES, MKI, PRACTICE	1	3	UXO	157	10
MORTAR, 3in STOKES, MKI, PRACTICE	1	12	UXO	157	15
PROJECTILE, 37mm, MKI, HE ROUND	1	5	UXO	157	20
MORTAR, 3in STOKES, MKI, PRACTICE	1	8	UXO	157	27
PROJECTILE, 75mm SHRAPNEL, MKI	1	0	UXO	170	227
OE Scrap Items:					
PROJECTILE FRAGMENTATION, 37mm	**	36	OE Scrap	11	2
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	36	OE Scrap	11	2
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	18	OE Scrap	11	3
FRAGMENTATION	**	0	OE Scrap	27	1
PROJECTILE, 3.8in SHRAPNEL, MKI, EXPENDED, w/FUZE, M1907 POWDER TRAIN TIME, w/PUSHER PLATE	1	12	OE Scrap	27	3
PROJECTILE, 3.8in SHRAPNEL, MKI, EXPENDED	1	18	OE Scrap	27	4
FRAGMENTATION	**	8	OE Scrap	27	5
FRAGMENTATION	**	2	OE Scrap	27	6
LEAD BALLS FROM SHRAPNEL ROUND	2	2	OE Scrap	27	6
PROJECTILE, 3.8in SHRAPNEL, MKI, EXPENDED, w/FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED, w/PUSHER PLATE	1	3	OE Scrap	27	7
LEAD BALLS FROM SHRAPNEL ROUND	**	2	OE Scrap	27	9
FRAGMENTATION	**	2	OE Scrap	27	11
FRAGMENTATION	**	0	OE Scrap	27	14
PROJECTILE, 75mm SHRAPNEL, MKI, EXPENDED	1	1	OE Scrap	27	15
PROJECTILES, 75mm SHRAPNEL, MKI, EXPENDED	**	1	OE Scrap	27	16
FRAGMENTATION	**	1	OE Scrap	27	16
LEAD BALLS FROM SHRAPNEL ROUND	**	1	OE Scrap	27	16
FRAGMENTATION	**	2	OE Scrap	27	17

Table 8-1
List of OE and OE Scrap Found in A1-Reconnaisance Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
PUSHER PLATE FROM SHRAPNEL ROUND	1	1	OE Scrap	27	18
PROJECTILE BASE, 75mm SHRAPNEL, MKI, EXPENDED	1	1	OE Scrap	27	21
PROJECTILE, 3.8in SHRAPNEL, MKI, EXPENDED w/FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	30	OE Scrap	27	22
FRAGMENTATION	**	6	OE Scrap	27	24
FRAGMENTATION	**	1	OE Scrap	27	25
FUZE, M1907 POWDER TRAIN TIME	1	1	OE Scrap	27	26
FRAGMENTATION	**	5	OE Scrap	27	27
FRAGMENTATION	**	2	OE Scrap	27	29
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	2	OE Scrap	27	30
FRAGMENTATION	**	1	OE Scrap	27	32
PROJECTILE, 3.8in SHRAPNEL, MKI, EXPENDED	1	12	OE Scrap	27	33
PROJECTILE, 3.8in SHRAPNEL, MKI, EXPENDED, w/FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	18	OE Scrap	27	34
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	4	OE Scrap	27	35
PROJECTILE, 75mm SHRAPNEL, MKI, w/FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	12	OE Scrap	27	38
FRAGMENTATION	**	1	OE Scrap	27	39
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	3	OE Scrap	27	40
PROJECTILE, 75mm SHRAPNEL, MKI, EXPENDED, w/FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED, w/PUSHER PLATE	1	18	OE Scrap	27	41
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	5	OE Scrap	27	42
FRAGMENTATION	**	2	OE Scrap	27	43
PROJECTILE, 75mm SHRAPNEL, MKI, EXPENDED	1	2	OE Scrap	27	44
PROJECTILE, 75mm SHRAPNEL, MKI, w/FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	12	OE Scrap	27	45
FRAGMENTATION	**	12	OE Scrap	27	47
PROJECTILE, 75mm SHRAPNEL, MKI, EXPENDED	1	15	OE Scrap	27	48
PUSHER PLATE	1	2	OE Scrap	27	49
FLASH TUBE	1	6	OE Scrap	27	50
FRAGMENTATION	**	6	OE Scrap	27	50

Table 8-1
List of OE and OE Scrap Found in A1-Reconnaisance Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	2	OE Scrap	27	51
PUSHER PLATE	1	2	OE Scrap	27	52
FRAGMENTATION	**	2	OE Scrap	27	52
PUSHER PLATE FROM SHRAPNEL ROUND w/ADAPTER, SHRAPNEL	1	12	OE Scrap	27	53
PROJECTILE, 75mm SHRAPNEL, MKI, EXPENDED	1	6	OE Scrap	27	55
PROJECTILE, 75mm SHRAPNEL, MKI, EXPENDED	1	12	OE Scrap	27	56
FRAGMENTATION	**	2	OE Scrap	27	59
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	4	OE Scrap	27	60
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	3	OE Scrap	27	61
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	6	OE Scrap	27	62
FRAGMENTATION	**	0	OE Scrap	27	63
FRAGMENTATION	**	1	OE Scrap	27	64
FLASH TUBE	1	4	OE Scrap	27	67
FRAGMENTATION	**	1	OE Scrap	27	68
PROJECTILE, 3.8in SHRAPNEL, MKI, EXPENDED w/ FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	26	OE Scrap	27	70
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	3	OE Scrap	27	72
FUZE RING	1	1	OE Scrap	27	73
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	0	OE Scrap	35	166
PROJECTILE, 75mm SHRAPNEL, MKI, EXPENDED	1	0	OE Scrap	35	167
SIGNAL, ILLUMINATION, GROUND, M127 SERIES, EXPENDED	1	2	OE Scrap	157	8
PROJECTILE FRAGMENTATIONATION, 37mm	1	0	OE Scrap	157	12
GRENADE BODY, 40mm	1	3	OE Scrap	164	41
Data from A1, A2, A3 Site Reconnaissance					
OE Scrap Items:					
PROJECTILE, 75mm SHRAPNEL	2	0	OE Scrap	N/A	N/A

*TtEC did not independently verify the accuracy nor currency of information supplied by client or by any of clients contractors, vendors, or consultants.
** Indeterminate amount.

8.3 DESCRIPTION OF HAZARDS OF SPECIFIC OE ENCOUNTERED

UXO items encountered during the site characterization of this OE Risk Assessment Sector include 3-inch (3in) practice Stokes Mortar rounds, a MKI 3.8in shrapnel projectile, MKI 37mm projectiles (HE and practice), and MKI 75mm shrapnel projectiles.

8.3.1 The MKI practice 3in Stokes Mortar shell consists of a cylindrical steel casing, having a steel base and steel head screwed on at each end of the casing. The steel head seats the booster jacket and MK VI setback-armed, impact-inertia fired, all-way trench mortar fuze. The steel base seats the cartridge container. Although the practice mortar is filled with 2.1 ponds of sand, the MK VI fuze combined with the booster contains approximately 65g of black powder. The ignition cartridge contained 45g of smokeless powder. The fuze safety pin and ring are removed before firing, leaving the set-back pellet supported by friction until the shell leaves the barrel. Upon acceleration the safety fork is ejected and the striker is free to reach the detonating pellet or percussion element upon impact. This fuze has a double percussion element which functions irrespective of the shells position upon impact (all-way). The fuze was painted black and stamped with manufacturer's symbols, and month and year of loading. The shell head was stamped with the name/Mk#, lot #, inspector's stamp, and manufacturer's symbol. The case painted dark blue with white stenciling. The ignition cartridge has a green case with a brass base, the bottom of which is stamped with manufacturer's information and the item's MK#.

8.3.2 The 3.8in common shrapnel projectile is a base-charged munition fitted with a Model 1907M 21-second combination fuze. The case is of forged alloy steel with a solid base. The rotating band is forced into an annular groove cut in the case 1.5" from the base. The front of the case is closed by a steel head, screwed in and tapped to take the fuze. The shrapnel bursting charge is composed of 0.33 ponds of black powder. The shrapnel filling is composed of 369 lead balls each weighing 215 grams. The balls are 0.54" in diameter. The interstices contain a smoke-producing matrix (naphthalene). The projectile was issued fuzed and ready for use and provided with a waterproof cover over the fuze to exclude moisture. When fixed, the case is not ruptured upon the explosion of the bursting charge, but the diaphragm, shrapnel balls, head, and fuze are expelled from the case in the same way shot is expelled from a shotgun cartridge.

8.3.4 This MKI 37mm projectile is made of bar steel and is filled with 0.034 ponds of black powder. It weighs approximately 1lb. Since it is adapted for a base fuze its nose is continued to a rounded point. The projectile is 3.56inches long and has a radius of ogive of 2.25 calibers. The fuze is a base percussion MK. I and is constructed of brass. It is an igniting fuze as indicated by "percussion" in the nomenclature. Its explosive train consists of a priming mixture and black powder which ignites the black powder bursting charge. The shell was painted red and stenciled in black. The MK I Sand-loaded (practice) projectile is exactly the same except for the fact that the black powder and live fuze of the Low Explosive (L.E.) shell were replaced by sand and an inert fuze.

8.3.5 The 75mm shrapnel projectile consists of a steel case, near the base of which a shoulder is formed on the interior surface. Three ounces of black powder is packed beneath a diaphragm of steel which rests on the shoulder. This diaphragm also supports a flash tube, the upper end of which is flared out into a smaller thin diaphragm. Between the two diaphragms is held a charge of melted resin which holds 270 lead balls suspended within it weighing 6 ponds, 7 ounces. The top of the case is closed by a steel head finely threaded to the top, and which is adapted to the

fuze with a coarse thread. It employs the 21-Second Combination Fuze M1907M which is covered with a metallic moisture proof cap. Either burning of the time element or firing of the percussion element on impact will ignite a black powder charge in the fuze. The flame from the magazine charge of the fuze flashes down the flash tube and ignites the base charge. Explosion of this charge forces the lower diaphragm, matrix and balls, and flash tube upward, blowing off the fuze and head as a unit. The resin matrix is ignited and the lead balls are ejected. The lead balls have a velocity of 350 feet/second in addition to the velocity of the projectile at the time of bursting. It was painted red and stenciled in black.

8.4 RISK ASSESSMENT

Figure 8-1, located at the end of this chapter, presents the CSM for potential exposures to OE in OE Risk Assessment Sector A1-Reconnaissance Area-D in Redevelopment Parcels M3 and M4. The primary sources were a firing point, various range safety fans located throughout the sector, a combat range, and impact/target areas. At the firing point, ordnance may be present due to mishandling, poor housekeeping, or loss. OE may be present in the range safety fans and the impact/target areas as the result of firing. OE may be present in the combat range area as the result of firing, poor housekeeping, mishandling, or loss. These releases likely result in OE being present on the ground surface or in the subsurface soils of the sector. Additionally, there was the potential for release to the limited surface water or sediments in this area. This CSM also indicates the principal mechanisms by which ordnance items may migrate from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another. These potential transport and migration mechanisms include mechanical redistribution, human activity, precipitation run-off, and (in limited, specific locations) erosion and frost heave. The original deposition of the ordnance items and the localized transport and migration processes result in a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. Potential direct contact with the surface water and sediments (as possible exposure media) is indicated, but OE presence in these areas has not been confirmed (represented as a dashed box in Figure 8-1, located at the end of this chapter). Receptors may include commercial or industrial workers, and construction workers associated with the redevelopment and land re-use. Terrestrial and aquatic wildlife may also be exposed to ordnance items present in the sector.

8.5 COMPARATIVE ANALYSIS OF RESPONSE ACTION ALTERNATIVES

8.5.1 Effectiveness

As described in Chapter 7.0, the criterion of Effectiveness has four major components for evaluating an alternative:

- Overall protectiveness to human health and the environment;
- Long-term effectiveness and permanence;
- Short-term effectiveness; and
- Compliance with ARARs.

8.5.1.1 The OERIA risk assessment process addresses the combined criteria of overall protectiveness to human health and the environment and long-term effectiveness and permanence. The results of the risk assessment performed for the A1-Reconnaissance Area-D sector using this process are presented in Figure 8-2, located at the end of this chapter. Based on these results, the most effective alternatives for the protection of human health and the environment were judged to be the removal alternatives. Alternative 6-Clearance to Depth was projected to provide the highest level of protectiveness throughout the sector, while Alternative 5-Clearance to 1 Foot Depth was judged to provide a lower level of protectiveness due to the indicated depth of OE in this area relative to the indicated future use for development. OE was found in this sector on the surface and within the first 15 inches of soil below the ground surface. OE Scrap was found in this sector on the surface and within 36 inches of the ground surface. Alternative 4-Surface Clearance received a low ranking because it would not be expected to remove OE from depths where it is indicated to be present and where future users of the area may disturb. Alternative 3-Construction Support is considered to be protective, but only within the future construction footprints within the sector where clearance of OE would be selectively performed. Alternative 2-Area-Specific Land Use Controls was considered to be less effective than any of the removal alternatives except for the case when Surface Clearance would be performed alone. Alternative 1-No Further Action was considered to be the least effective. Since development / redevelopment activities are planned for this sector, Alternative 6 would provide the highest level of protectiveness, followed by Alternative 5.

8.5.1.2 With respect to the other effectiveness criteria, Alternative 1-No Further Action clearly has the least short-term impacts since No Further Action is being taken that might affect on local workers or the public. Alternative 2, Area-Specific Land Use Controls, also presents little short-term effects since the only activity that might have impact on the workers or the public involves installation of a limited number of warning signs. The removal alternatives (Alternatives 3 through 6) have the greatest potential impact on the workers and public since each involves the potential of more direct contact with OE. Overall, Alternative 1 will have the least short-term impacts, followed by Alternative 2 and 3, and then Alternatives 4, 5, and 6. Among the latter three alternatives, the short-term effects will increase from Alternatives 4 to 6, since each has a potential for longer and more intense exposure to OE. With respect to the compliance with ARARs criterion, each alternative will comply.

8.5.2 Implementability

As described in Chapter 7.0, the criterion of implementability has five major components for evaluating an alternative:

- Technical feasibility;
- Administrative feasibility;
- Availability of services and materials;
- Regulatory acceptance; and
- Community acceptance.

8.5.2.1 Technical Feasibility

All six alternatives are technically feasible with Alternative 1 being the most technically feasible as there is No Further Action required at the site (i.e., investigation or removal actions). Alternative 2 is the second most technically feasible alternative. It requires that technical actions be taken at the site (i.e., installation of signage at the site). The remaining alternatives are each technically feasible, but less so than Alternatives 1 and 2 because they each involve more intense site activities and a greater dependence on technology. In summary, Alternative 1 will be the most technically feasible, followed by Alternative 2 with Alternatives 3 through 6 descending in feasibility in sequential order.

8.5.2.2 Administrative Feasibility

All six alternatives will require the preparation and DDESB-approval of an ESS document. Alternatives 3 through 6 will each require the preparation and approval of a Work Plan since each alternative involves onsite OE activities. Alternatives 2, 3, 4, and 5 will also require compliance with the LUCAP for Fort McClellan, since each involves the implementation of land use controls. In summary, considering these requirements, Alternative 1 will be the simplest to administer, with Alternative 6 next, and Alternatives 2, 3, 4, and 5 being the most difficult of the alternatives to administer due to the inclusion of land use controls and the requirements to comply with the LUCAP.

8.5.2.3 Availability of Services and Materials

Services and materials will be required and are readily available for preparing the plans mentioned above and to complete the fieldwork associated with Alternatives 3 through 6. Based on the levels of services needed, Alternative 1 will require the least services and materials since it only requires effort to prepare the ESS. More services and materials will be required for the implementation of Alternative 2 since it requires the preparation of the ESS, installation of signs, as well as coordination with the LUCAP. Even more services and materials will be required for Alternative 3 as it requires a work plan to support construction support activities and the field service activities to provide the actual construction support. Alternative 4 will be similar in scope of required services and materials. Alternatives 5 and 6 will require the most in services and materials. In summary, Alternative 1 will require the least in services and materials to

implement, with Alternative 2 next. Alternatives 3 and 4 will require a higher level of services and materials than Alternatives 1 and 2, but less than Alternatives 5 and 6.

8.5.2.4 Regulatory and Community Acceptance

The level of regulatory and/or community acceptance for each alternative can be expected to largely depend on the protection that each alternative offers. For this sector, OE has been detected on the surface and up to 36 inches below land surface, in an area where the future land use is projected to be Development. Alternative 1-No Further Action does nothing to provide any further degree of protection and therefore is unlikely to be accepted by the regulatory community or the public. Alternative 2-Area-Specific Land Use Controls would probably not be received favorably since it will provide only limited protection to members of the public involved in intrusive activities (i.e., excavations, etc.). Alternative 3-Construction Support may be received favorably since it provides protection to construction workers and to the public in that it also includes the land use controls of Alternative 2. Alternative 4-Surface Clearance may be expected to receive a similar level of acceptance as Alternative 3. It includes removal of potential OE from the surface (not subsurface) across the entire sector, not just within construction footprints and is accompanied by land use controls. However, the belief that significant numbers of subsurface OE may be present may lead to a reduced acceptance of this alternative. Alternative 5-Clearance to One Foot Depth and Alternative 6-Clearance to Depth may receive the highest level of acceptance by both regulators and the public as they both involve a subsurface removal of potential OE in an area expected to experience significant subsurface excavations during development.

8.5.2.4.1 In summary, the alternatives that may be best received by the regulators and/or public would be Alternative 5-Clearance to One Foot Depth and Alternative 6-Clearance to Depth, followed in order by Alternative 4-Surface Clearance, Alternative 3-Construction Support, Alternative 2-Area-Specific Land Use Controls, and lastly, Alternative 1-No Further Action.

8.5.3 Cost

The projected costs to implement the alternatives in this 160-acre sector are summarized below:

- Alternative 1 - No Further Action – $5,000. An ESS (preparation, draft, and final) will be prepared for a group of sectors. This cost is an approximation of one sector's portion of the total cost.

- Alternative 2 - Area-Specific Land Use Controls – $29,600. This cost includes planning and installation of signage. No annual maintenance costs are included.

- Alternative 3 - Construction Support – $633,256. This estimate includes management, planning, and UXO support.

- Alternative 4 - Surface Clearance – $1,373,328. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 5 - Clearance to One-Foot Depth – $3,076,377. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 6 - Clearance to Depth – $3,177,634. This cost includes management and planning, OE removal activities, and reporting.

8.6 RECOMMENDATION

The recommended alternative for A1-Reconnaissance Area-D is Alternative 6-Clearance to Depth. Components of this alternative will include land surveying and brush clearing operations to prepare the site. Due to the requirement to detect items potentially deeper than one foot, this alternative will be performed using sensitive instruments capable of detecting anomalies at greater depths. Using a suitably sensitive detection system, the entire study area will be surveyed to locate potential OE items. The anomalies will then be investigated to identify them as UXO, OE Scrap, or Non-OE Scrap (metallic scrap). After identification, the items will be disposed of as scrap or OE in accordance with the previously-approved OE operations work plan.

8.6.1 Planning for this response action will require preparation of an ESS and a site-specific removal action work plan. The estimated cost to implement this alternative is $3,177,635.

8.7 SUPPORTING RATIONALE

The risk analysis and the comparative analysis indicated that clearance to depth should provide sufficient protection for this sector. During the sampling conducted in this sector as part of the Bravo EE/CA, no UXO or OE Scrap was found below 36 inches. However, several UXO were found; one at 15 inches. OE Scrap items were found to a depth of 36 inches. During the site reconnaissance of the A1 area, two expended 75mm shrapnel rounds were found on the surface. The documented historical use of this area, combined with the OE items found within this area and being so close to the main cantonment area, all support the proposed removal action.

Figure 8-1
A1-Reconnaissance Area-D
CONCEPTUAL SITE MODEL

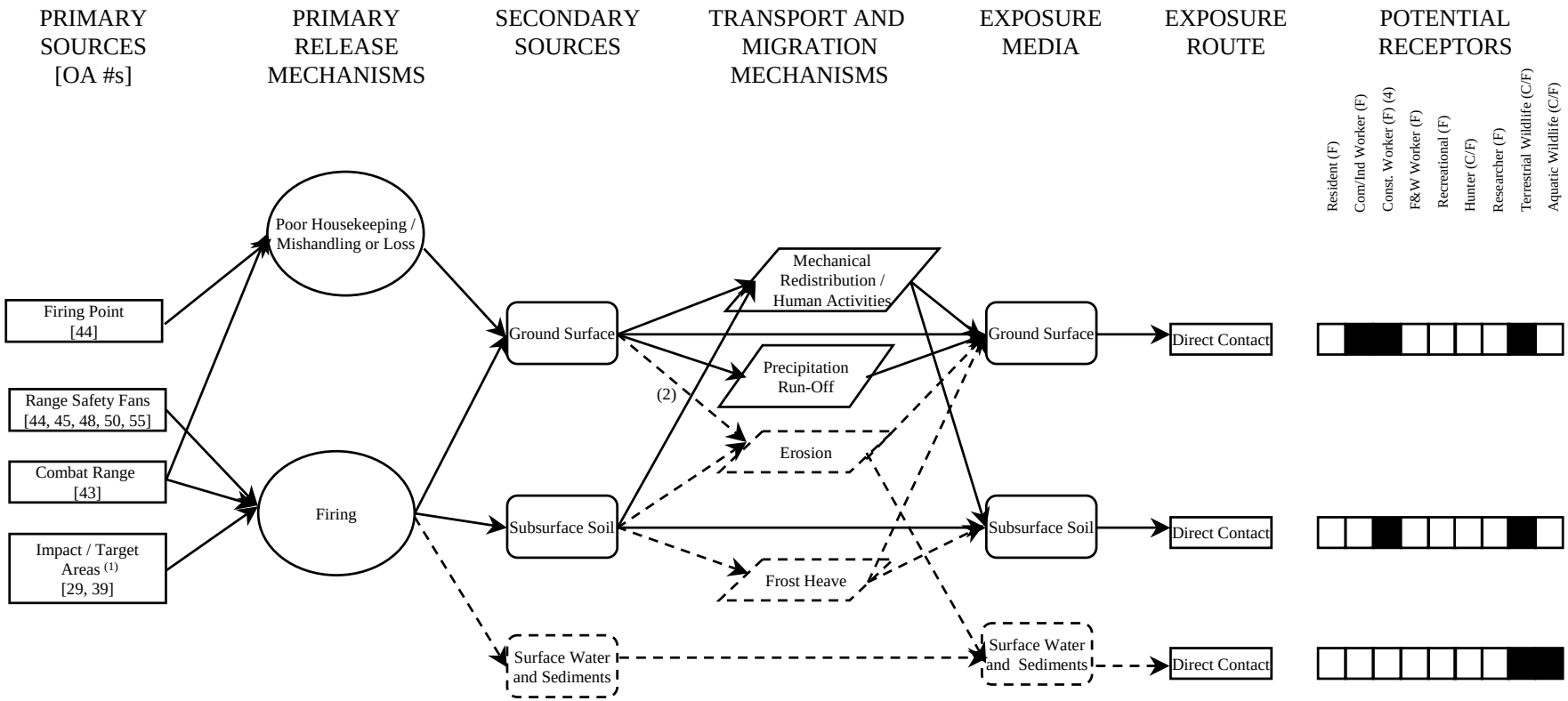


PLATE NOS. (3)	OA#	NAME	ORDANCE AND EXPLOSIVES ASSOCIATED WITH AREA
3, 4, 10	29	World War I Artillery Range (North Half)	Artillery Munitions; Mortars
3, 4, 10	39	World War I Artillery Range (South Half)	Artillery Munitions; Mortars
4, 5, 10	43	Combat Range #1	37mm Anti-Tank; 75mm Artillery Guns; 81mm Mortar Rounds
5, 6, 7, 10	44	Washington Rifle Range (Range 18)	Small Arms
5, 6, 7, 10	45	Range 16 (originally, later Rocket Launcher/Bazooka Range and Range17 (Rifle Grenade))	Grenade Court; Small Arms; 40mm grenades (launched); Rockets
5, 6, 10	55	Old Range 12 (Range 12; Rifle Field Firing)	Small Arms
6, 7, 10	48	Range 12 (a.k.a. Range 14)	Small Arms; Light Anti-Tank Weapon; 60mm Mortars; Rockets
6, 7, 10	50	Range 19	Small Arms

NOTES:
(1) Indicated firing point is for non-Small Arms munitions.
(2) Dashed boxes or lines indicate a potential source area or linkage that requires further verification or is a linkage that is indicated to be present in only a small number of specific locations.
(3) Plate numbers obtained from Fort McClellan Archives Search Report
(4) Within footprint of future development activity.
C = Current Receptor
F = Potential Future Receptor

Figure 8-2 **OERIA TABLE FOR SECTOR A-1 RECONNAISSANCE AREA-D**

AREA: **BRAVO**
SECTOR: **A-1 Reconnaissance Area-D**
TOTAL SECTOR AREA: **161 acres**
AREA GEOPHSICALLY SURVEYED: **35.16 acres [3]**
AREA INTRUSIVELY INVESTIGATED: **1.74 acres (equivalent) [4]**

	ORDNANCE								SITE		HUMAN CURRENT USE			HUMAN FUTURE USE				OVERALL RANK	
	HE Items Found? [Yes]	OE Type [7]		OE Sensitivity [7]		OE Item Depth Distribution		OE Item Density	OE Site Access	OE Site Stability	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Likelihood of Near Term Reuse	CURRENT LAND USE	FUTURE LAND USE
	HE Debris Found? [Yes]		(%)		(%)	Depth Range	% [9]	(Items/Acre) [8,9,12]											
Baseline Risk Assessment (Existing Conditions)		Cat. 3	60	Cat. 3	60	Surface	10 / *{12.2}*	0.028 / *{0.25}*	No Restriction to Site	Site Stable	Recreational [13,17]	Significant [18]	Occassional [19]	Development [16,33]	Significant [18]	Frequent	High		
		Cat. 2	0.0	Cat. 2	0.0	0 to 1' bgs	80 / *{68.9}*	4.60 / *{29.3}*											
		Cat. 1	40	Cat. 1	40	1' to Depth	10 / *{18.9}*	0.57 / *{8.04}*											
		Cat. 0	*	Cat. 0	*	Overall [11]		5.75 / *{42.5}*											
						90% CI on Overall OE Item Density [10]		3.55 - 9.73											
Alternative 1 - No Further Action		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	No Impact		No Impact	No Impact		BASELINE	BASELINE
Alternative 2 - Land Use Controls		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	B		No Impact	B		LOW	LOW
Alternative 3 - Construction Support		No Impact		No Impact		A [21]			No Impact	No Impact		A [21]	A [21]		A [21]	A [21]		MODERATE [20]	MODERATE [20]
Alternative 4 - Surface Clearance		No Impact		No Impact		C			No Impact	No Impact		B	A [23]		C	A [23]		LOW	LOW
Alternative 5 - Clearance to 1 Foot Depth		No Impact		No Impact		B			No Impact	No Impact		A	A [22]		B	A [22]		HIGH	MODERATE [37]
Alternative 6 - Clearance to Depth		A		A		A			No Impact	No Impact		A	A [22]		A	A [22]		HIGH	HIGH

NOTES

3 The Geophysically Surveyed Area includes the area associated with the transects within this specific sector.
4 Based on the fraction of identified target anomalies intrusively investigated in each geophysically surveyed grid and/or transect segment.
7 Percentages classify OE items found. If no OE items are found, Category 0 is 100% and Categories 1 - 3 are noted with a "*". If OE items are found, Category 0 is noted with a "*".
8 OE Density values shown are the straight average value = # of OE Items / Acres in which they were found.
9 Densities and depth range percentages shown in italics and curley brackets indicate characteristics of the OE debris.
10 The OE Density range shown represents a 90% confidence interval on the OE Item density calculated using UXO Calculator Version 1.4.2.
11 Overall OE item density is based on all OE Items found in the area intrusively investigated.
12 The surface OE item density is based on the area geophysically surveyed and the 0-1' and 1'-Depth OE item densities are based on the area intrusively investigated.
13 Specific activities identified for the recreational current land use include hunting, hiking, and short cuts.
16 Development land use was assumed to be associated with routine interaction with the surface and near-surface soils by the employees of the new facilities. In addition, the construction of new facilities, structures, or underground utilities and the maintenance or replacement of existing structures or utilities was assumed to be reasonably associated with this land use.
17 Exposure to terrestrial wildlife is also assumed.
18 Based on the depth of intrusion associated with the identified activities - See Table 5 of USACE OERIA Interim Guidance (3/27/01).
19 The frequency of site usage is currently classified as rare and the number of site users is currently classified as low due to restrictions that have been placed on the site (i.e., no hunting or hiking) since the remediation activities began. The current frequency of usage would be classified as occassional if these recreational activities took place.
20 Indicated to be the most protective alternative within the construction footprint.
21 Risk factor score indicated applies only within the construction footprint.
22 No increased protectiveness relative to alternatives with a shallower clearance depth due to the depth distribution of OE items found.
23 Removal of surface OE items or debris may reduce the number of potential exposures to souvenir hunters.
33 Future Development activities are projected to be associated with Mixed Business Use.
37 Protectiveness may be greater given the effect of the deed restriction prohibiting digging.

IMPACT CODE

A = Signifiies the greatest impact on reducing potential exposures to OE; Relatively less impact as the letter ranking goes to B, C, and subsequent letters.
HIGH - Most protective relative to projected land use.
LOW - Least protective relative to projected land use.
MODERATE - Protectiveness level between Low and High.
BASELINE - Protectiveness level associated with Alternative 1 - No Further Action.

9.0 M3-1H-Grenade Area-D

9.1 DESCRIPTION AND HISTORY

This sector consists of 31 acres located on the northern border of the Bravo Area. Combat Range #2 (OA-52) and a Machine Gun Range (OA-2) were historically located in a portion of M3-1H Grenade Area-D. Combat Range #2, constructed during the Inter-War period, was divided into several uses including a rocket range, a machine gun range, and two rifle grenade ranges. The Rifle Grenade Ranges were used during WWII and both were abandoned by 1958. The Machine Gun Range, used during WWII, was part of Combat Range #2. It was used as a rifle grenade range during WWII and was abandoned in 1958. This sector has a future land use of Retail and Mixed Business (i.e., some development).

9.1.1 Clearance to Depth was performed within M3-1H-Grenade Area-D, as part of an interim removal action of the EBP "Y" Area Junction between April and November 2003 (see section on Interim Removal Actions in Chapter 2). The final report is in Draft Final form and there is currently no statement of clearance.

9.2 INVESTIGATION RESULTS

During the site characterization of Bravo, delineation transects were an investigation method used specifically to characterize suspected areas with a high likelihood of containing OE in this OE Risk Assessment Sector. The following delineation transects were placed in this OE Risk Assessment Sector: part of M31H009, part of M31H010, and part of M31M008. In this OE Risk Assessment Sector, the following data collection transects (or clusters), consisting of a series of 200-foot long, parallel segments spaced 25 to 50 feet apart, were investigated: part of M31L402, part of M31L403, part of M31L404, part of M31M106, M31M108, M31M110, part of M31M112, part of M31M115, M31M116, part of M31M117, M31M119, M31M122, and part of M31M123. A total of 1.98 acres were geophysically mapped and 1.34 acres were intrusively investigated in these transects.

9.2.1 One UXO item was found at a depth of 12 inches and 14 OE Scrap items were found on the surface and up to a depth of 8 inches. Table 9-1 contains a list of OE and OE Scrap items found within this OE Risk Assessment Sector. Figure B-2 in Appendix B presents an overview figure of the Bravo Area with this OE Risk Assessment Sector and Appendix F contains a list of all items from the database found within this OE Risk Assessment Sector.

9.3 DESCRIPTION OF HAZARDS OF SPECIFIC OE ENCOUNTERED

The one UXO item encountered during the site characterization of this OE Risk Assessment Sector was a MKI practice 3in Stokes Mortar round. The MKI practice 3in Stokes Mortar shell consists of a cylindrical steel casing, having a steel base and steel head screwed on at each end of the casing. The steel head seats the booster jacket and MK VI setback-armed, impact-inertia fired, all-way trench mortar fuze. The steel base seats the cartridge container. Although the practice mortar is filled with 2.1 ponds of sand, the MK VI fuze combined with the booster contains approximately 65 g of black powder. The ignition cartridge contained 45 g of smokeless powder. The fuze safety pin and ring are removed before firing, leaving the set-back

pellet supported by friction until the shell leaves the barrel. Upon acceleration the safety fork is ejected and the striker is free to reach the detonating pellet or percussion element upon impact. This fuze has a double percussion element which functions irrespective of the shells position upon impact (all-way). The fuze was painted black and stamped with manufacturer's symbols, and month and year of loading. The shell head was stamped with the name/Mk#, lot #, inspector's stamp, and manufacturer's symbol. The case painted dark blue with white stenciling. The ignition cartridge has a green case with a brass base, the bottom of which is stamped with manufacturer's information and the item's MK#.

Table 9-1
List of OE and OE Scrap Found in M3-1H Grenade Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
UXO Items:					
MORTAR, 3in STOKES, MKI, PRACTICE	1	12	UXO	M31m116	3
OE Scrap Items:					
MINE, LAND, PRACTICE	1	0	OE Scrap	M31l403	194
SIGNAL, ILLUMINATION, GROUND, M127 SERIES, EXPENDED	1	1	OE Scrap	M31l404	1
MINE, PRACTICE, ANTI-TANK	1	3	OE Scrap	M31m116	1
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	4	OE Scrap	M31m116	2
GRENADE FUZE	1	2	OE Scrap	M31m119	3
ROCKET BODY, 2.36in,	1	0	OE Scrap	M31m119	4
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	0	OE Scrap	M31m119	4
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	5	OE Scrap	M31m119	7
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	6	OE Scrap	M31m119	13
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	6	OE Scrap	M31m122	4
GRENADE SPOON	1	6	OE Scrap	M31m123	13
MORTAR FIN ASSEMBLY, 60mm, ILLUMINATION	1	8	OE Scrap	M31m123	16
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	1	OE Scrap	M31m123	18
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	2	OE Scrap	M31m123	19

*TtEC did not independently verify the accuracy nor currency of information supplied by client or by any of clients contractors, vendors, or consultants.
** Indeterminate amount.

9.4 RISK ASSESSMENT

Figure 9-1, located at the end of this chapter, presents the CSM for potential exposures to OE in OE Risk Assessment Sector M3-1H-Grenade Area-D in Redevelopment Parcel M3. The primary sources include a combat range/training area and a portion of a range safety fan located in the sector. OE may be present in the combat range/training area as a result of firing or poor housekeeping, mishandling, or loss. OE may be present in the range safety fan as the result of

firing. These releases likely result in OE being present on the ground surface or in the subsurface soils of the sector. Additionally, there was the potential for release to the limited surface water or sediments in this area. This CSM also indicates the principal mechanisms by which ordnance items may migrate from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another. These potential transport and migration mechanisms include mechanical redistribution, human activity, precipitation run-off, and (in limited, specific locations) erosion and frost heave. The original deposition of the ordnance items and the localized transport and migration processes result in a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. Potential direct contact with the surface water and sediments (as possible exposure media) is indicated, but OE presence in these media has not been confirmed (represented as a dashed box in Figure 9-1, located at the end of this chapter). Receptors may include Active Recreational users of the area. In addition, future users may include site workers and construction workers associated with the redevelopment and land re-use. Terrestrial and aquatic wildlife may also be exposed to ordnance items present in the sector.

9.5 COMPARATIVE ANALYSIS OF RESPONSE ACTION ALTERNATIVES

9.5.1 Effectiveness

The OERIA risk assessment process addresses the combined criteria of overall protectiveness to human health and the environment and long-term effectiveness and permanence. The results of the risk assessment performed for the M3-1H-Grenade Area-D sector using this process are presented in Figure 9-2, located at the end of this chapter. Based on these results, the most effective alternatives for the protection of human health and the environment were judged to be the removal alternatives. Alternative 6-Clearance to Depth was projected to provide the highest level of protectiveness throughout the sector, while Alternative 5-Clearance to 1 Foot Depth was judged to provide a lower level of protectiveness due to the indicated depth of OE in this area relative to the indicated future use for development. Only one OE item was found in this sector at a depth of twelve inches below the ground surface. OE Scrap was found on the surface and within 8 inches of the ground surface. Alternative 4-Surface Clearance received a low ranking because it would not be expected to remove OE from depths where it is indicated to be present and where future users of the area may disturb. Alternative 3-Construction Support is considered to be protective, but only within the future construction footprints within the sector where clearance of OE would be selectively performed. Alternative 2-Area-Specific Land Use Controls was considered to be less effective than any of the removal alternatives except for the case when Surface Clearance would be performed alone. Alternative 1-No Further Action was considered to be the least effective. Since development/redevelopment activities are planned for this sector, Alternative 6 would provide the highest level of protectiveness, followed by Alternative 5.

9.5.1.1 With respect to the other effectiveness criteria, Alternative 1 - No Further Action, clearly has the least short-term impacts since No Further Action is being taken that might impact local workers or the public. Alternative 2-Area-Specific Land Use Controls, also presents little short-term effects since the only activity that might have impact on the workers or the public involves installation of a limited number of warning signs. The removal alternatives

(Alternatives 3, 4, 5, and 6) have the greatest potential impact on the workers and public since each involves the potential of more direct contact with OE. Overall, Alternative 1 will have the least short-term impacts, followed by Alternatives 2 and 3, and then Alternatives 4, 5, and 6. Among the latter three alternatives, the potential short-term effects will generally increase from Alternatives 4 to 6, since each has a potential for longer and more intense exposure to OE. With respect to the compliance with ARARs criterion, each alternative will comply.

9.5.2 Implementability

9.5.2.1 Technical Feasibility

All six alternatives are technically feasible with Alternative 1 being the most technically feasible since there is No Further Action required at the site (i.e., investigation or removal actions). Alternative 2 is the second most technically feasible alternative. It requires that technical actions be taken at the site (i.e., installation of signage at the site). The remaining alternatives are each technically feasible but less so than Alternatives 1 and 2, because they each involve more intense site activities and dependence on technology. In summary, Alternative 1 will be the most technically feasible, Alternative 2 next, followed by Alternatives 3, 4, 5 and 6.

9.5.2.2 Administrative Feasibility

All six alternatives will require the preparation and DDESB approval of an ESS document. Alternatives 3 through 6 will each require the preparation and approval of a work plan since each alternative involves onsite OE activities. Alternatives 2, 3, 4, and 5 will also require compliance with the LUCAP for Fort McClellan, each involves the implementation of land use controls. In summary, considering these requirements, Alternative 1 will be the easiest to administer, with Alternative 6 next, and Alternatives 2, 3, 4, and 5 being the most difficult of the alternatives to administer due to the inclusion of land use controls and the requirements to comply with the LUCAP.

9.5.2.3 Availability of Services and Materials

Services and materials are required and are readily available for preparing the plans mentioned above and to complete the fieldwork associated with Alternatives 3 through 6. Based on the levels of services needed, Alternative 1 will require the least services and materials as it only requires effort to prepare the ESS. More services and materials will be required for the implementation of Alternative 2 since it requires the preparation of the ESS, installation of signs, as well as coordination with the LUCAP. Even more services and materials will be required since Alternative 3 requires a work plan to support construction support activities and the field service activities to provide the actual construction support. Alternative 4 will be similar in scope of required services and materials. Alternatives 5 and 6 will require the most in services and materials. In summary, Alternative 1 will require the least in services and materials to implement, with Alternative 2 next. Alternatives 3 and 4 will require a higher level of services and materials than Alternatives 1 and 2, but less than Alternatives 5 and 6.

9.5.2.4 Regulatory and Community Acceptance

The level of regulatory and/or community acceptance for each alternative can be expected to largely depend on the protection that each alternative offers. For this sector, OE was found within one foot below land surface and OE Scrap was detected on the surface and up to eight inches below land surface. The projected future land use is Development. Alternative 1-No Further Action does nothing to provide any degree of protection and therefore is unlikely to be accepted by the regulatory community or the public. Alternative 2-Area-Specific Land Use Controls would probably not be received favorably since it will provide only limited protection to members of the public involved in intrusive activities (i.e., excavations, etc.). Alternative 3-Construction Support may be received favorably since it provides protection to construction workers and to the public in that it also includes the land use controls of Alternative 2. Alternative 4-Surface Clearance may be expected to receive a similar level of acceptance as Alternative 3. It includes removal of potential OE from the surface (not subsurface) across the entire sector, not just within construction footprints, and is accompanied by land use controls. However, the belief that significant numbers of subsurface OE may be present may lead to a reduced acceptance of this alternative. Alternative 5 (Clearance to One-Foot Depth) and Alternative 6-Clearance to Depth may receive the highest level of acceptance by both regulators and the public as they both involve a subsurface removal of potential. OE is in an area expected to experience significant subsurface excavations during development.

9.5.2.4.1 In summary, the alternatives that may be best received by the regulators and/or public would be Alternative 5-Clearance to One Foot Depth and Alternative 6-Clearance to Depth, followed in order by Alternative 4-Surface Clearance, Alternative 3-Construction Support, Alternative 2-Area-Specific Land Use Controls, and lastly, Alternative 1-No Further Action.

9.5.3 Cost

The projected costs to implement the alternatives in this 31-acre sector are summarized below:

- Alternative 1 - No Further Action – $5,000. An ESS (preparation, draft, and final) will be prepared for a group of sectors. This cost is an approximation of one sector's portion of the total cost.

- Alternative 2 - Area-Specific Land Use Controls – $17,000. This cost includes planning, and installation of signage. No annual maintenance costs are included.

- Alternative 3 - Construction Support – $142,850. This estimate includes management; UXO support; and planning.

- Alternative 4 - Surface Clearance – $229,420. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 5 - Clearance to One-Foot Depth – $533,277. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 6 - Clearance to Depth – $552,068. This cost includes management and planning, OE removal activities, and reporting.

9.6 RECOMMENDATION

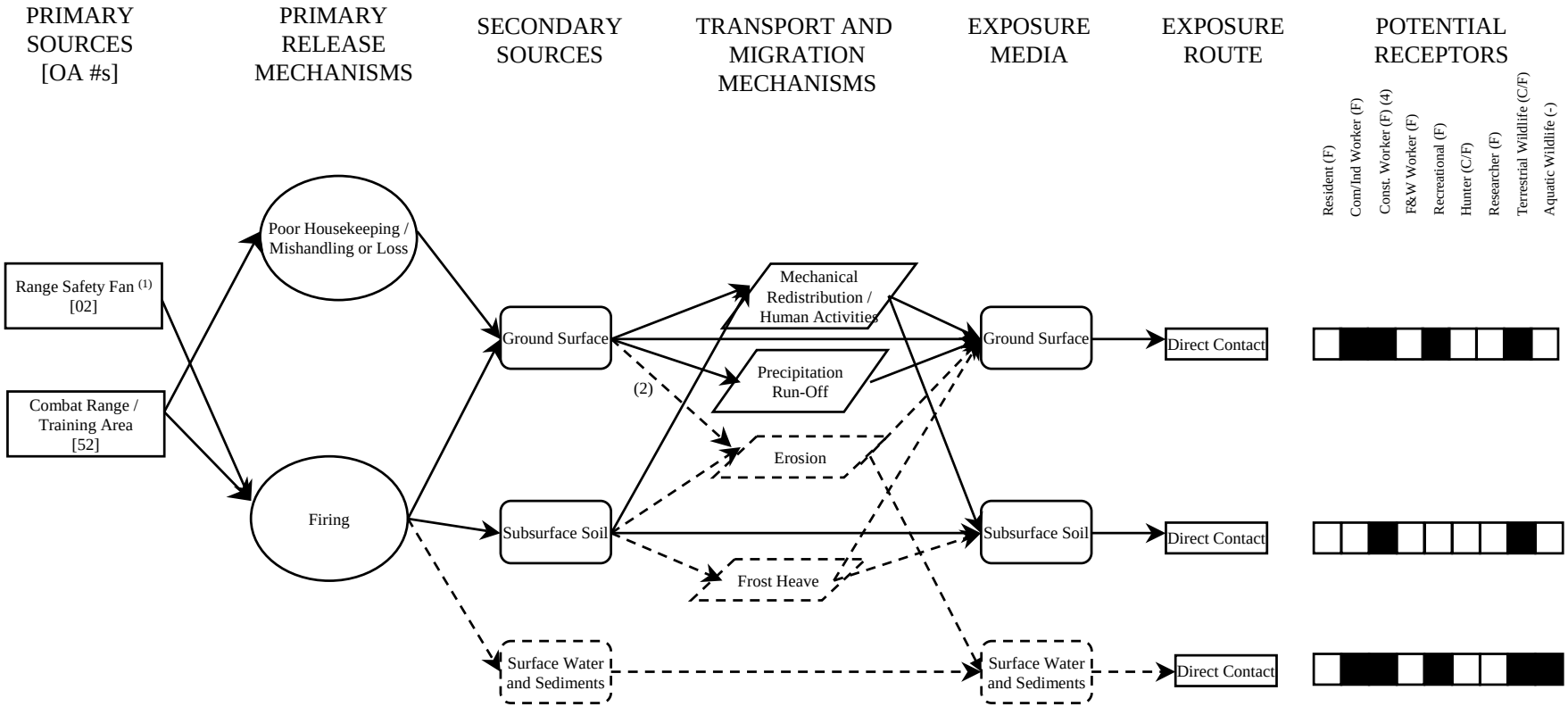
The recommended alternative for M3-1H-Grenade Area-D is Alternative 6-Clearance to Depth. Components of this alternative will include land surveying and brush clearing operations to prepare the site. Due to the requirement to detect items potentially deeper than one foot, this alternative will be performed using sensitive instruments capable of detecting anomalies at greater depths. Using a suitably sensitive detection system, the entire study area will be surveyed to locate potential UXO items. The anomalies will then be intrusively investigated to identify them as UXO, OE Scrap, or Non-OE Scrap (metallic scrap). After identification, the items will be disposed of as scrap or OE in accordance with the previously-approved OE operations work plan.

9.6.1 Planning for this response action will require preparation of an ESS and a site-specific removal action work plan. The estimated cost to implement this alternative is $552,068.

9.7 SUPPORTING RATIONALE

The risk analysis and the comparative analysis indicated that clearance to depth should provide sufficient protection for this sector. In this sector, the OE Scrap items were found on the surface and down to 8 inches and one UXO item was found at a depth of 12 inches. This area is also near an area of the Eastern Bypass with heavy OE contamination. The documented historical use of this area, combined with the OE items found within this area, and this area being so close to the main cantonment area all support the proposed removal action.

Figure 9-1
M3-1H-Grenade Area-D
CONCEPTUAL SITE MODEL



NOTES:
(1) For non-Small Arms munitions.
(2) Dashed boxes or lines indicate a potential source area or linkage that requires further verification or is a linkage that is indicated to be present in only a small number of specific locations.
(3) Plate numbers obtained from the Fort McClellan Archives Search Report
(4) Within footprint of future development activity
C = Current Receptor
F = Potential Future Receptor
- = Not plausible for this sector

PLATE NOS. (3)	OA#	NAME (Other Names)	ORDANCE AND EXPLOSIVES ASSOCIATED WITH AREA
4,10	52	Combat Range #2 (a.k.a. Rocket Range; Machine Gun Range; 2 Rifle Grenade Ranges)	Rockets; Small Arms; Rifle Grenades
5, 10	02	Machine Gun Range	Small Arms

Figure 9-2 **OERIA TABLE FOR SECTOR M3-1H-GRENADE AREA-D**

AREA: **BRAVO**
SECTOR: **M3-1H-Grenade Area-D**
TOTAL SECTOR AREA: **31 acres**
AREA GEOPHSICALLY SURVEYED: **1.98 acres [3]**
AREA INTRUSIVELY INVESTIGATED: **1.34 acres (equivalent) [4]**

	ORDNANCE								SITE		HUMAN CURRENT USE			HUMAN FUTURE USE				OVERALL RANK	
	HE Items Found? [No]	OE Type [7]		OE Sensitivity [7]		OE Item Depth Distribution		OE Item Density	OE Site Access	OE Site Stability	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Likelihood of Near Term Reuse	CURRENT LAND USE	FUTURE LAND USE
	HE Debris Found? [Yes]		(%)		(%)	Depth Range	% [9]	(Items/Acre) [8,9,12]											
Baseline Risk Assessment (Existing Conditions)		Cat. 3	0.0	Cat. 3	0.0	Surface	*- / {21.4}*	*- / {1.52}*	No Restriction to Site	Site Stable	Recreational [13,17]	Significant [18]	Occassional [19]	Development [16,33]	Significant [18]	Frequent	High		
		Cat. 2	0.0	Cat. 2	0.0	0 to 1' bgs	*100 / {78.6}*	*0.75 / {8.21}*											
		Cat. 1	100	Cat. 1	100	1' to Depth	*- / { - }*	*- / { - }*											
		Cat. 0	*	Cat. 0	*	Overall [11]		*0.75 / {10.4}*											
						90% CI on Overall OE Item Density [10]		0.26 - 3.45											
Alternative 1 - No Further Action		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	No Impact		No Impact	No Impact		BASELINE	BASELINE
Alternative 2 - Land Use Controls		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	B		No Impact	B		LOW	LOW
Alternative 3 - Construction Support		No Impact		No Impact		A [21]			No Impact	No Impact		A [21]	A [21]		A [21]	A [21]		MODERATE [20]	MODERATE [20]
Alternative 4 - Surface Clearance		No Impact		No Impact		No Impact			No Impact	No Impact		B	A [23]		B	A [23]		LOW	LOW
Alternative 5 - Clearance to 1 Foot Depth		A		A		A			No Impact	No Impact		A	A		B	A		HIGH	MODERATE
Alternative 6 - Clearance to Depth		A [22]		A [22]		A [22]			No Impact	No Impact		A	A [22]		A	A [22]		HIGH	HIGH

NOTES

3 The Geophysically Surveyed Area includes the area associated with the transects within this specific sector.
4 Based on the fraction of identified target anomalies intrusively investigated in each geophysically surveyed grid and/or transect segment.
7 Percentages classify OE items found. If no OE items are found, Category 0 is 100% and Categories 1 - 3 are noted with a "*". If OE items are found, Category 0 is noted with a "*".
8 OE Density values shown are the straight average value = # of OE Items / Acres in which they were found.
9 Densities and depth range percentages shown in italics and curley brackets indicate characteristics of the OE debris.
10 The OE Density range shown represents a 90% confidence interval on the OE Item density calculated using UXO Calculator Version 1.4.2.
11 Overall OE item density is based on all OE Items found in the area intrusively investigated.
12 The surface OE item density is based on the area geophysically surveyed and the 0-1' and 1'-Depth OE item densities are based on the area intrusively investigated.
13 Specific activities identified for the recreational current land use include hunting, hiking, and short cuts.
16 Development land use was assumed to be associated with routine interaction with the surface and near-surface soils by the employees of the new facilities. In addition, the construction of new facilities, structures, or underground utilities and the maintenance or replacement of existing structures or utilities was assumed to be reasonably associated with this land use.
17 Exposure to terrestrial wildlife is also assumed.
18 Based on the depth of intrusion associated with the identified activities - See Table 5 of USACE OERIA Interim Guidance (3/27/01).
19 The frequency of site usage is currently classified as rare and the number of site users is currently classified as low due to restrictions that have been placed on the site (i.e., no hunting or hiking) since the remediation activities began. The current frequency of usage would be classified as occassional if these recreational activities took place.
20 Indicated to be the most protective alternative within the construction footprint.
21 Risk factor score indicated applies only within the construction footprint.
22 No increased protectiveness relative to alternatives with a shallower clearance depth due to the depth distribution of OE items found.
23 Removal of surface OE items or debris may reduce the number of potential exposures to souvenir hunters.
33 Future Development activities are projected to be associated with Active Recreation, Retail, and Transportation Uses.
- = Not applicable as no energetic OE items were found.

IMPACT CODE

A = Signifiies the greatest impact on reducing potential exposures to OE; Relatively less impact as the letter ranking goes to B, C, and subsequent letters.
HIGH - Most protective relative to projected land use.
LOW - Least protective relative to projected land use.
MODERATE - Protectiveness level between Low and High.
BASELINE - Protectiveness level associated with Alternative 1 - No Further Action.

10.0 M3-1H-Grenade Area-PR

10.1 DESCRIPTION AND HISTORY

This sector consists of 86 acres located on the northern border of the Bravo Area. The Eastern Bypass boundary divides M3-1H-Grenade Area-PR into two pieces. Two rifle grenade ranges (OA-51), Combat Range #2 (OA-52), and a skeet range (OA-75) were historically located in this area. Combat Range #2, constructed during the Inter-War period, had several uses including a rocket range, a machine gun range, and two rifle grenade ranges. The two rifle grenade ranges were used during WWII and both were abandoned by 1958. The sector has a future land use of Passive Recreation.

10.1.1 Clearance to Depth was performed within a portion of M3-1H-Grenade Area-PR as part of an interim removal action of the EBP "Y" Area Junction between April and November 2003; and as part of an interim removal action of the Water Tank Construction Sites between December 2003 and May 2004 (see section on Interim Removal Actions in Chapter 2). The final reports are in Draft Final (January 2004) and Final (May 2006) form.

10.2 INVESTIGATION RESULTS

During the site characterization of Bravo, 4 grids in this OE Risk Assessment Sector were geophysically mapped and 2 of these grids were then intrusively investigated. Two grids (136 and 139) were characterized by surface finds. Grid 136 is partially located in this OE Risk Assessment Sector and in OE Risk Assessment Sector M3-1H-Mixed Use Area-D. Delineation transects were a second investigation method used specifically to characterize suspected areas with a high likelihood of containing OE in this OE Risk Assessment Sector. The following delineation transects were placed in this OE Risk Assessment Sector: part of M31H003, part of M31H005, M31H006, part of M31H007, part of M31H009, and part of M31H010. The following data collection transects (or clusters), consisting of a series of 200-foot long, parallel segments spaced 25 to 50 feet apart, were investigated: M31L401, part of M31L402, part of M31L403, part of M31L404, M31M053 – M31M056, part of M31M057, part of M31M058, M31M060, part of M31M099 - M31M102, part of M31M106, part of M31M112, and part of M31M115. A total of 1.24 acres in grids and 3.15 acres in transects were geophysically mapped. A total of 0.37 acres in grids and 1.79 acres in transects were intrusively investigated.

10.2.1 Six UXO items were found on the surface and 1 at a depth of six inches. Four UXO items were found on the surface by IT Corporation in this OE Risk Assessment Sector. Fourteen OE Scrap items were found at shallow depths, as well as an indeterminate quantity of OE Scrap items. The Old Burn Pit area investigated by Parsons is located in this OE Risk Assessment Sector southeast of Grid 587. Burn Pit 1 contained multiple inert items, practice items, and metal debris. Findings included 23 practice rifle grenade bodies, 2 practice 60mm mortars with fins, an 81mm mortar round with no fuze or primer, 2 rifle grenade tail booms, and multiple .30 caliber casings and clips. Burn Pit 2 contained a steel box with cans, wire-wrapped cans, plate glass, and 1 MK2 practice grenade. Burn Pit 3 contained flakes of rust and jar lids (Parsons, 2001). Table 10-1 contains a list of OE and OE Scrap items found within this OE Risk Assessment Sector. Figure B-2 in Appendix B presents an overview figure of the Bravo Area with this OE Risk Assessment Sector and Appendix F contains a list of all items from the

database found within this OE Risk Assessment Sector. Appendix F also contains the findings in the Old Burn Pits.

Table 10-1
List of OE and OE Scrap Items Found in M3-1H Grenade Area-PR

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
UXO Items:					
RIFLE GRENADE, AT, M9	1	0	UXO	136	24
ROCKET, HEAT, 2.36in, M6	1	0	UXO	136	25
RIFLE GRENADE, PRACTICE, M11	3	0	UXO	141	27
GRENADE, HAND, MKII	1	6	UXO	587	9
GRENADE, RIFLE, AT, M9	1	0	UXO	M31m053	12
Data Provided by Other Subcontractors:					
ROCKETS, 2.36in	2	0	UXO	IT25	N/A
ROCKETS, 2.36in	2	0	UXO	IT26	N/A
OE Scrap Items:					
MORTAR, 3in STOKES, MKI, PRACTICE	2	0	OE Scrap	136	22
ROCKETS, PRACTICE, 2.36in, M7	3	0	OE Scrap	136	23
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	136	256
RIFLE GRENADE TAIL BOOMS	**	0	OE Scrap	136	257
RIFLE GRENADE TAIL BOOMS	**	0	OE Scrap	139	258
RIFLE GRENADE, PRACTICE, M11	1	2	OE Scrap	141	6
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	141	26
GRENADE FUZE	1	3	OE Scrap	M31l402	1
SIGNAL, ILLUMINATION, GROUND, M127 SERIES, EXPENDED	1	3	OE Scrap	M31l402	1
SIGNAL, ILLUMINATION, GROUND, M127 SERIES, EXPENDED	1	5	OE Scrap	M31l402	2
RIFLE GRENADES, PRACTICE, M11	2	0	OE Scrap	M31m106	62
Data Provided by Other Subcontractors:					
RIFLE GRENADE BODIES, PRACTICE	23	48	OE Scrap	PBP1	N/A
MORTARS, 60mm, PRACTICE W/FINS	2	48	OE Scrap	PBP1	N/A
MORTAR, 81mm, EMPTY, NO FUZE	1	48	OE Scrap	PBP1	N/A
RIFLE GRENADE TAIL BOOMS	2	48	OE Scrap	PBP1	N/A
.30-cal CASINGS AND CLIPS	multiple	48	OE Scrap	PBP1	N/A
GRENADE, MK2, PRACTICE	1	12	OE Scrap	PBP2	N/A

Note: This table does not list small arms finds.

Note: IT# = IT Corporation finds. PBP# = Parsons Burn Pit finds.

*TtEC did not independently verify the accuracy nor currency of information supplied by client or by any of clients contractors, vendors, or consultants.
** Indeterminate amount.

10.3 DESCRIPTION OF HAZARDS OF SPECIFIC OE ENCOUNTERED

UXO items encountered during the site characterization of this OE Risk Assessment Sector include an M9 Rifle Grenade AT, a 2.36in M6 rocket, a M11 practice rifle grenade, and a MK11 hand grenade. The M9 Rifle Grenade, AT, is a dedicated rifle grenade that weighs about 1.3

pounds, is approximately 11 inches long, and contains a shaped charge. The charge consists of a 4 ounce package of trinitrol toluene (TNT). This grenade can penetrate 3 to 4 inches of armor and has a maximum effective range of 250 yards. It was designed to detonate on impact.

10.3.1 The 2.36in rocket consists of three parts: the high-explosive head, the stabilizer tube, and the fin assembly. This rocket has a 0.5 pound 50/50 pentolite with a 10/90 pentolite booster. The rocket can penetrate three inches of homogenous-steel armor plate at all ranges and at angles of impact as low as 90 degrees. The propellant consists of five sticks of ballistite. The fuze generally consists of a steel firing pin that slips into the central cavity of the fuze body. The fuze body contains the Detonator of M18 of lead azide and a tetryl, and the booster charge of tetryl. It was determined that these items had a high explosive anti-tank (HEAT) or Shape charge with the potential to produce explosive fragments.

10.3.2 The M11 practice rifle grenade is a dummy (inert) grenade similar in size, shape, and weight to the M9 HE Rifle Grenade. It consists of two parts a head and a fin assembly (replaceable). It has a sheet metal body and weighs 1.5 pounds. It was fired using a special calibers. .30 carbine and rifle grenade launcher attachment for the M1903A1 and M1917 U.S. calibers. .30 Rifle. These grenades were used for target practice only.

10.3.3 The MKII hand grenade body is made of cast iron. It is about the size and shape of a lemon. The outside surface is deeply serrated, horizontally and vertically, to form fragments of effective size. The opening in the top is threaded to accept a fuze. The grenade weighs about 1 pound empty. It is loaded with 0.74 ounces of E.C. Blank smokeless powder. The powder is generally pink or yellow in color. It is fuzed with the M10A2 Hand Grenade Igniting Fuze. A cotter pin with a ring extends through holes in the fuze and the lever, holding the lever and striker assembly in place against the action of the spring. When the cotter pin is removed and the lever released, the spring rotates the striker around the hinge pin. The striker impacts the primer and explodes the primer charge which ignites a 2 inch piece of time fuze. This burns for approximately 5 seconds before conducting the flame to the igniting charge which explodes the grenade.

10.4 RISK ASSESSMENT

Figure 10-1, located at the end of this chapter presents the CSM for potential exposures to OE in OE Risk Assessment Sector M3-1H-Grenade Area-PR in Redevelopment Parcel M3. The primary sources include various firing points and range safety fans and a combat range/training area located within the sector. OE may be present in the range safety fans as a result of firing. At the firing points, ordnance may have been released due to mishandling, poor housekeeping, or loss. OE may be present in the combat range/training area as a result of firing or poor housekeeping, mishandling, or loss. These releases likely result in OE being present on the ground surface or in the subsurface soils of the sector. Additionally, there was the potential for release to surface water or sediments. This CSM also indicates the principal mechanisms by which ordnance items may migrate from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another. These potential transport and migration mechanisms include mechanical redistribution, human activity, precipitation run-off, and (in limited, specific locations) erosion and frost heave. The original deposition of the ordnance items and the localized transport and migration processes result in a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact

exposure by current or reasonably foreseeable future receptors associated with reuse of the area. Potential direct contact with the surface water and sediments (as possible exposure media) is indicated, but OE presence in these media has not been confirmed (represented as a dashed box in Figure 10-1 located at the end of this chapter). Receptors may include Passive Recreational users of the area. Terrestrial and aquatic wildlife may also be exposed to ordnance present in the sector. No significant construction activity is projected to be associated with this land use. However, soil disturbance within a specified area may be considered on an infrequent and spatially limited basis. As such, a construction worker would not be a routine receptor relative to the entire sector.

10.5 COMPARATIVE ANALYSIS OF RESPONSE ACTION ALTERNATIVES

10.5.1 Effectiveness

The OERIA risk assessment process addresses the combined criteria of overall protectiveness to human health and the environment and long-term effectiveness and permanence. The results of the risk assessment performed for the M3-1H-Grenade Area-PR sector using this process are presented in Figure 10-2, located at the end of this chapter. Based on these results, the most effective alternatives for the protection of human health and the environment were judged to be the removal alternatives. Both Alternative 6-Clearance to Depth and Alternative 5-Clearance to 1 Foot Depth were projected to provide the highest level of protectiveness throughout the sector, while Alternative 4- Surface Clearance was judged to provide a somewhat lower level of protectiveness due to the indicated depth of OE in this area relative to the indicated future use for passive recreation. Several OE items were found on the surface and one OE item at depth of six inches. OE Scrap was found within 48 inches of the ground surface. Alternative 4-Surface Clearance received a lower ranking (compared to Alternatives 5 and 6) because it would not be expected to remove OE from depths where it is indicated to be present and where future users of the area may disturb. Alternative 3-Construction Support is considered to be protective, but only within any potential future construction footprint within the sector where clearance of OE would be selectively performed. Alternative 2-Area-Specific Land Use Controls was considered to be less effective than any of the removal alternatives. Alternative 1-No Further Action was considered to be the least effective. Since passive recreation activities are planned for this sector, Alternative 5-Clearance to 1 Foot Depth was considered to provide a high level of protectiveness, with Alternative 6 providing only an incremental increase in protectiveness.

10.5.2 Implementability

10.5.2.1 Technical Feasibility

All six alternatives are technically feasible with Alternative 1 being the most technically feasible as there is No Further Action required at the site (i.e., investigation or removal actions). Alternative 2 is the second most technically feasible alternative. It requires that technical actions be taken at the site (e.g., installation of signage at the site). The remaining alternatives are each technically feasible but less so than Alternatives 1 and 2, because they each involve more intense site activities and dependence on technology. In summary, Alternative 1 will be the most technically feasible, Alternative 2 next, followed by Alternatives 3, 4, 5, and 6.

10.5.2.2 Administrative Feasibility

All six alternatives will require the preparation and DDESB approval of an ESS document. Alternatives 3 through 6 will each require the preparation and approval of a work plan since each alternative involves onsite OE activities. Alternatives 2, 3, 4, and 5 will also require compliance with the LUCAP for Fort McClellan, since each involves the implementation of land use controls. In summary, considering these requirements, Alternative 1 will be the easiest to administer, with Alternative 6 next, and Alternatives 2, 3, 4, and 5 being the most difficult of the alternatives to administer due to the inclusion of land use controls and the requirements to comply with the LUCAP.

10.5.2.3 Availability of Services and Materials

Services and materials are required and are readily available for preparing the plans mentioned above and to complete the fieldwork associated with Alternatives 3 through 6. Based on the levels of services needed, Alternative 1 will require the least services and materials since it only requires effort to prepare the ESS. More services and materials will be required for the implementation of Alternative 2 since it requires the preparation of the ESS, installation of signs, as well as coordination with the LUCAP. Even more services and materials will be required since Alternative 3 requires a work plan to support construction support activities and the field service activities to provide the actual construction support. Alternative 4 will be similar in scope of required services and materials. Alternatives 5 and 6 will require the most in services and materials. In summary, Alternative 1 will require the least in services and materials to implement, with Alternative 2 next. Alternatives 3 and 4 will require higher level of services and materials than Alternatives 1 and 2, but less than Alternatives 5 and 6.

10.5.2.4 Regulatory and Community Acceptance

The level of regulatory and/or community acceptance for each alternative can be expected to largely depend on the protection that each alternative offers. For this sector, several OE items were found on the surface and one OE item at a depth of six inches. OE Scrap was found within one foot below ground surface. The only OE Scrap items found below one foot were items identified by Parsons during a separate investigation of the Old Burn Pit Area. Alternative 1-No Further Action does not provide any degree of protection and, therefore, is unlikely to be accepted by the regulatory community or the public. Alternative 2-Area-Specific Land Use Controls would be received more favorably as it will provide some degree of protection, however, since it leaves potential OE in place, it may be received poorly by both regulators and the public. Alternative 3-Construction Support may receive similar levels of acceptance as Alternative 2. Alternative 3 provides protection to construction workers and removes OE within the construction footprint. The projected future land use is Passive Recreation, with little expected construction activities. Alternative 4-Surface Clearance may be expected to receive an even higher level of acceptance than any of the previous alternatives since it includes actual removal of potential OE from the surface and is accompanied by land use controls. On the other hand, the belief that significant numbers of subsurface OE may be present may lead to a reduced acceptance of this alternative. Alternative 5-Clearance to One-Foot Depth and Alternative 6-Clearance to Depth may receive the highest level of acceptance by both regulators and the public since they both involve a subsurface removal of potential OE.

10.5.2.4.1 In summary, the alternatives that may be best received by the regulators and/or public would be Alternative 5-Clearance to One Foot Depth and Alternative 6-Clearance to Depth, followed in order by Alternative 4-Surface Clearance, Alternative 2-Area-Specific Land Use Controls, Alternative 3-Construction Support, and lastly, Alternative 1-No Further Action.

10.5.3 Cost

The projected costs to implement the alternatives in this 86-acre sector are summarized below:

- Alternative 1 - No Further Action – $5,000. An ESS (preparation, draft, and final) will be prepared for a group of sectors. This cost is an approximation of one sector's portion of the total cost.

- Alternative 2 - Area-Specific Land Use Controls – $17,000. This cost includes planning and installation of signage. No annual maintenance costs are included.

- Alternative 3 - Construction Support – $351,938. This estimate includes management and planning and UXO Support.

- Alternative 4 - Surface Clearance – $674,939. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 5 - Clearance to One-Foot Depth – $1,834,839. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 6 - Clearance to Depth – $1,965,689. This cost includes management and planning, OE removal activities, and reporting.

10.6 RECOMMENDATION

The recommended alternative for M3-1H-Grenade Area-PR is Alternative 5-Clearance to One Foot. Components of this alternative will include land surveying and brush clearing operations to prepare the site. Where technically feasible, suitably sensitive detection instruments will be used to survey the study area and locate subsurface anomalies, which subsequently will be investigated down to 12 inches. After identification, the item will be disposed of as scrap or OE in accordance with a previously-approved OE operations work plan. A deed restriction that prohibits digging in this sector without construction support by UXO-qualified personnel will also be included.

10.6.1 Planning for this response action will require preparation of an ESS and a site-specific work plan. The estimated cost to implement this alternative is $1,834,839.

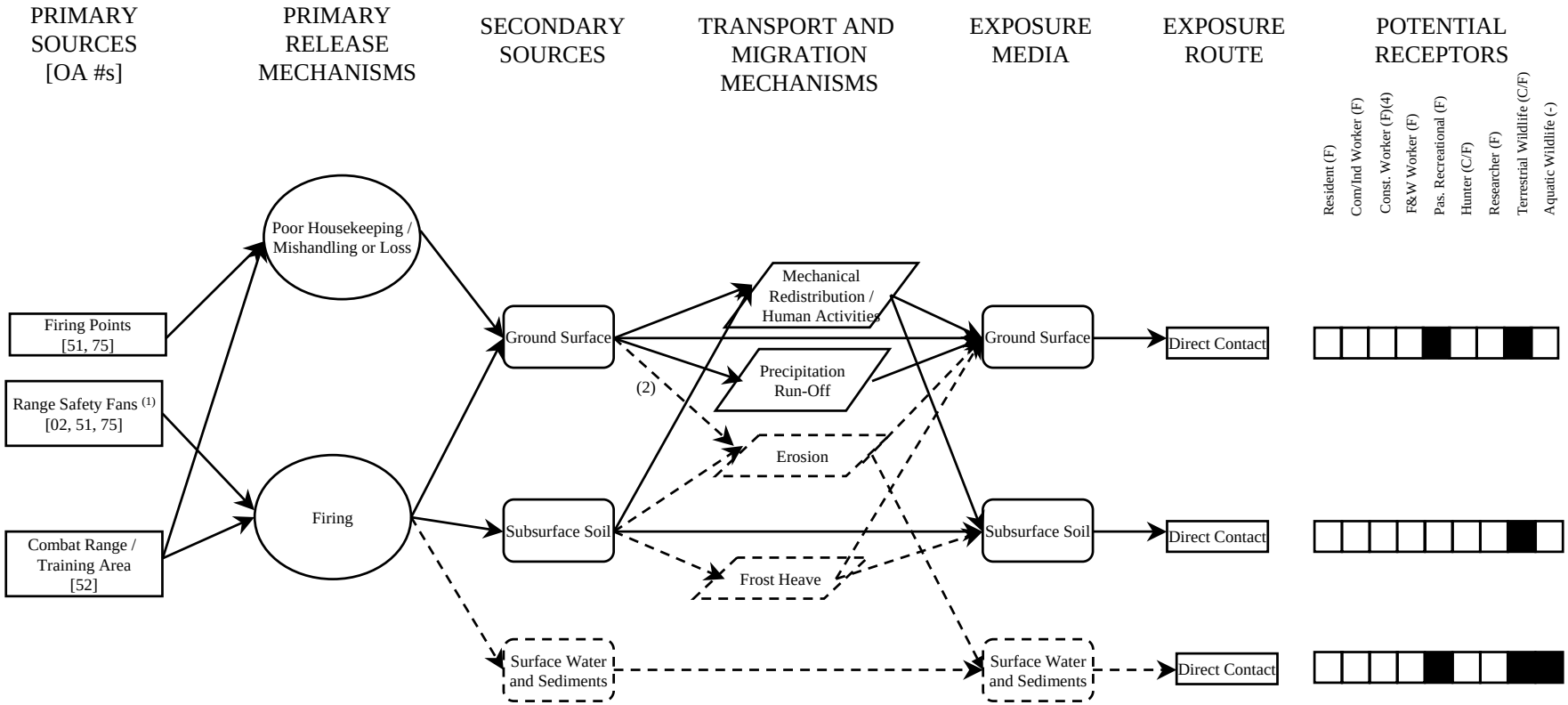
10.7 SUPPORTING RATIONALE

The risk analysis and the comparative analysis indicated that clearance to one foot should provide sufficient protection for this sector. Several UXO items were found on the surface and one at a depth of six inches in this sector. The OE Scrap items were found at a maximum depth of five inches with the exception of OE Scrap items found below one foot by Parsons during a separate investigation of the Old Burn Pit Area. The projected land use is Passive Recreation,

associated with activities such as hiking, walking, and biking. No significant construction of recreational facilities or underground utilities is associated with this land use. Consistent with Passive Recreation land use is the occasional incidental interaction with surface and very near surface (0 – 6 inches) soils. The recommendation of clearance to one foot provides a safety buffer of 2 beyond the expected depth (6 inches) of contact. Since all items found were near the surface and other items are expected to be near the surface, clearance to one foot should be sufficiently protective.

THIS PAGE INTENTIONALLY LEFT BLANK.

Figure 10-1
M3-1H-Grenade Area-PR
CONCEPTUAL SITE MODEL



NOTES:
(1) For non-Small Arms munitions.
(2) Dashed boxes or lines indicate a potential source area or linkage that requires further verification or is a linkage that is indicated to be present in only a small number of specific locations.
(3) Plate numbers obtained from the Fort McClellan Archives Search Report
(4) No significant construction activity is expected for this land use. Limited disturbance of the soil may be considered within a specific footprint for the installation of facilities associated with the land use.
C = Current Receptor
F = Potential Future Receptor
- = Not plausible for this sector

PLATE NOS. (3)	OA#	NAME (Other Names)	ORDANCE AND EXPLOSIVES ASSOCIATED WITH AREA
4, 10	52	Combat Range #2 (a.k.a. Rocket Range; Machine Gun Range; 2 Rifle Grenade Ranges)	Rockets; Small Arms; Rifle Grenades
5, 10	02	Machine Gun Range	Small Arms
5, 10	51	2 Rifle Grenade Ranges	Rifle Grenades (WWII era)
7, 10	75	Skeet Range	Various Gauge Shotguns

Figure 10-2 **OERIA TABLE FOR SECTOR M3-1H-GRENADE AREA-PR**

AREA: **BRAVO**
SECTOR: **M3-1H-Grenade Area-PR**
TOTAL SECTOR AREA: **87 acres**
AREA GEOPHSICALLY SURVEYED: **4.39 acres [3]**
AREA INTRUSIVELY INVESTIGATED: **2.16 acres (equivalent) [4]**

	ORDNANCE								SITE		HUMAN CURRENT USE			HUMAN FUTURE USE				OVERALL RANK	
	HE Items Found? [Yes]	OE Type [7]		OE Sensitivity [7]		OE Item Depth Distribution		OE Item Density	OE Site Access	OE Site Stability	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Likelihood of Near Term Reuse	CURRENT LAND USE	FUTURE LAND USE
	HE Debris Found? [Yes]		(%)		(%)	Depth Range	% [9]	(Items/Acre) [8,9,12]											
Baseline Risk Assessment (Existing Conditions)		Cat. 3	47	Cat. 3	47	Surface	94.1 / *{25}*	3.64 / *{2.51}*	No Restriction to Site	Site Stable	Recreational [13,17]	Significant [18]	Occassional [19]	Passive Recreation [14]	Significant [18]	Occassional [19]	High		
		Cat. 2	0.0	Cat. 2	0.0	0 to 1' bgs	5.88 / *{11.4}*	0.46 / *{2.31}*											
		Cat. 1	53	Cat. 1	53	1' to Depth	- / *{63.6}*	- / *{ 13}*											
		Cat. 0	*	Cat. 0	*	Overall [11]		7.87 / *{20.4}*											
						90% CI on Overall OE Item Density [10]		5.41 - 11.8											
Alternative 1 - No Further Action		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	No Impact		No Impact	No Impact		BASELINE	BASELINE
Alternative 2 - Land Use Controls		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	B		No Impact	B		LOW	LOW
Alternative 3 - Construction Support		No Impact		No Impact		A [21]			No Impact	No Impact		A [21]	A [21]		A [21]	A [21]		MODERATE [20]	MODERATE [20]
Alternative 4 - Surface Clearance		No Impact		No Impact		No Impact			No Impact	No Impact		B	A [23]		B	A [23]		MODERATE	MODERATE
Alternative 5 - Clearance to 1 Foot Depth		A		A		A			No Impact	No Impact		A	A		A	A		HIGH	HIGH
Alternative 6 - Clearance to Depth		A [22]		A [22]		A [22]			No Impact	No Impact		A	A [22]		A	A [22]		HIGH	HIGH

NOTES

3 The Geophysically Surveyed Area includes the area associated with the transects within this specific sector.
4 Based on the fraction of identified target anomalies intrusively investigated in each geophysically surveyed grid and/or transect segment.
7 Percentages classify OE items found. If no OE items are found, Category 0 is 100% and Categories 1 - 3 are noted with a "*". If OE items are found, Category 0 is noted with a "*".
8 OE Density values shown are the straight average value = # of OE Items / Acres in which they were found.
9 Densities and depth range percentages shown in italics and curley brackets indicate characteristics of the OE debris.
10 The OE Density range shown represents a 90% confidence interval on the OE Item density calculated using UXO Calculator Version 1.4
11 Overall OE item density is based on all OE Items found in the area intrusively investigated.
12 The surface OE item density is based on the area geophysically surveyed and the 0-1' and 1'-Depth OE item densities are based on the area intrusively investigated.
13 Specific activities identified for the recreational current land use include hunting, hiking, and short cuts.
14 Specific activities associated with the passive recreation future land use are hiking, walking, biking, picnicking, horseback riding, and other non-motorized activities.
17 Exposure to terrestrial wildlife is also assumed.
18 Based on the depth of intrusion associated with the identified activities - See Table 5 of USACE OERIA Interim Guidance (3/27/01).
19 The frequency of site usage is currently classified as rare and the number of site users is currently classified as low due to restrictions that have been placed on the site (i.e., no hunting or hiking) since the remediation activities began. The current frequency of usage would be classified as occassional if these recreational activities took place.
20 Indicated to be the most protective alternative within the construction footprint.
21 Risk factor score indicated applies only within the construction footprint.
22 No increased protectiveness relative to alternatives with a shallower clearance depth due to the depth distribution of OE items found.
23 Removal of surface OE items or debris may reduce the number of potential exposures to souvenir hunters.
24 Protectiveness based on intrusion depth; Given the observed depth distribution of OE Items, the level of protectiveness associated with this alternative may be greater.
- = Not applicable as no energetic OE items were found.

IMPACT CODE

A = Signifiies the greatest impact on reducing potential exposures to OE; Relatively less impact as the letter ranking goes to B, C, and subsequent letters.
HIGH - Most protective relative to projected land use.
LOW - Least protective relative to projected land use.
MODERATE - Protectiveness level between Low and High.
BASELINE - Protectiveness level associated with Alternative 1 - No Further Action.

11.0 M3-1H-Mixed Use Area-D

11.1 DESCRIPTION AND HISTORY

This OE Risk Assessment Sector consists of 169 acres located near the northern border of the Bravo Area and has a projected land use of Development Reserve. This sector is bordered by the Eastern Bypass Study Area on the west. M3-1H-Grenade Area-PR separates a small portion of this area to the west. Historically, a portion of Range 13 (OA-49), Range 19 (OA-50), Combat Range #2 (OA-52), and a portion of a skeet range (OA-75) and two WWII-era Rifle Grenade Ranges (OA-51) were located in this area. Range 13, the Washington Pistol Qualification Range, was established during the Vietnam War and was active until base closure. Range 19 was built during the Vietnam War as a 10m Machine Gun Range and was later used as a Pistol Qualification Range. During a site visit, remnants of WWII vintage rifle grenades were found northeast of Range 19, on the south side of an old service road. Combat Range #2 was built during the Inter-War period. There is no documentation of its initial use, but during the war it was divided into several ranges including a rocket range, a machine gun range, and two rifle grenade ranges, all of which were abandoned by 1958. The Rifle Grenade Ranges were used during WWII and both were abandoned by 1958. The firing fans for two historical small arms ranges (OA-2 and OA-48) extend into this sector.

11.1.1 Clearance to Depth was performed within a portion of M3-1H-Mixed Use Area-D as part of an interim removal action of the Water Tank Construction Sites between December 2003 and May 2004 (see section on Interim Removal Actions in Chapter 2). The final report is in Final form (May 2006) and the statement of clearance was signed June 2006.

11.2 INVESTIGATION RESULTS

During the site characterization of Bravo, 13 grids in this OE Risk Assessment Sector were geophysically mapped and 5 of these grids were then intrusively investigated. Delineation transects were a second investigation method used specifically to characterize suspected areas with a high likelihood of containing OE in this OE Risk Assessment Sector. The following delineation transects were placed in this OE Risk Assessment Sector: M31H001, M31H002, part of M31H003, M31H004, part of M31H005, M31H006, part of M31H007, part of M32H009, part of M32H020, part of M32H022, part of M32H024, M32H026, and M32H028. The following data collection transects (or clusters), consisting of a series of 200-foot long, parallel segments spaced 25 to 50 feet apart, were investigated: M31M009 – M31M018, part of M31M019, M31M022, part of M31M057, part of M31M058, M31M059, M31M097, M31M098, part of M31M099 – M31M102, M31M103 – M31M105, M31M126, and part of M31M127. A total of 4.20 acres in grids and 5.13 acres in transects were geophysically mapped. A total of 0.51 acres in grids and 1.20 acres in transects were intrusively investigated.

11.2.1 Fifteen UXO items were found on the surface and up to depths of 13 inches. Approximately 174, OE Scrap items with some indeterminate amounts, were found on the surface, at shallow depths, and a few items at depth. Four UXO items were also found by IT. Table 11-1 contains a list of OE and OE Scrap items found within this OE Risk Assessment Sector. Figure B-2 in Appendix B presents an overview figure of the Bravo Area with this OE Risk Assessment Sector and Appendix F contains a list of all items from the database found within this OE Risk Assessment Sector.

Table 11-1
List of OE and OE Scrap Items Found in M3-1H Mixed Use Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
UXO Items:					
MORTAR, 3in STOKES, MKI PRACTICE	1	12	UXO	133	1
MORTAR, 3in STOKES, MKI PRACTICE	1	3	UXO	133	5
MORTAR, 3in STOKES, MKI PRACTICE	1	0	UXO	134	1
PROJECTILE, 37mm HE	1	0	UXO	M31m010	3
FUZE, POWDER TRAIN TIME, M1907	1	0	UXO	M31m012	48
ROCKET, HEAT, 2.36in, M6	1	0	UXO	M31m012	49
PROJECTILE, 75mm SHRAPNEL, MKI	1	0	UXO	M31m012	64
PROJECTILE, 3.8in SHRAPNEL, MKI	1	0	UXO	M31m012	65
MORTARS, 3in STOKES, MKI, PRACTICE	3	0	UXO	M31m012	66
MORTAR, 81mm HE, M43	1	4	UXO	M31m103	58
ROCKET, HEAT, 2.36in, M6	1	1	UXO	M31m103	61
ROCKET, HEAT, 2.36in, M6	1	1	UXO	M31m103	61
ROCKET, HEAT, 2.36in, M6	1	13	UXO	M31m126	9
Data Provided by Other Subcontractors:*					
ROCKET, 2.36in	1	0	UXO	IT22	N/A
ROCKET, 2.36in	1	0	UXO	IT24	N/A
PROJECTILE, 37mm	1	0	UXO	IT27	N/A
MORTAR, 3in STOKES	1	0	UXO	IT31	N/A
OE Scrap Items:					
MORTAR, 3in STOKES, MKI PRACTICE	1	12	OE Scrap	133	2
MORTAR, 3in STOKES, MKI PRACTICE	1	12	OE Scrap	133	4
PULL RING	1	5	OE Scrap	133	15
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	133	16
PULL RING	1	0	OE Scrap	133	17
PROJECTILE, 37mm APC, M51	1	6	OE Scrap	133	30
MORTAR, 3in STOKES, MKI, PRACTICE	1	0	OE Scrap	133	259
GRENADE FRAGMENTATION, RIFLE	**	0	OE Scrap	134	1
GRENADE FUZE	1	3	OE Scrap	134	2
PROJECTILE FRAGMENTATION, 37mm	**	3	OE Scrap	134	3
HAND GRENADE FUZE	1	3	OE Scrap	134	3
PROJECTILE, 37mm APC, M51	1	6	OE Scrap	134	4
PROJECTILE FRAGMENTATION, 37mm	2	1	OE Scrap	134	5
PROJECTILE FRAGMENTATION, 37mm	2	9	OE Scrap	134	6
PROJECTILE FRAGMENTATION, 37mm	1	5	OE Scrap	134	8
GRENADE FUZE	1	1	OE Scrap	134	9
PROJECTILE FRAGMENTATION, 37mm	1	3	OE Scrap	134	10
MKII FRAGMENTATIONATION	2	3	OE Scrap	134	10
PROJECTILE FRAGMENTATION, 37mm	1	4	OE Scrap	134	11
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	134	12
SIGNAL FRAGMENTATION, SMOKE, GROUND, M62 SERIES	**	3	OE Scrap	134	13
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	134	14
GRENADE FRAGMENTATION, HAND	**	2	OE Scrap	134	14
PROJECTILE FRAGMENTATION, 37mm	1	1	OE Scrap	134	16
PROJECTILE FRAGMENTATION, 37mm	**	1	OE Scrap	134	17
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	134	18

Table 11-1
List of OE and OE Scrap Items Found in M3-1H Mixed Use Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	134	19
SIGNAL, SMOKE, GROUND, M62 SERIES, TAIL BOOM	1	2	OE Scrap	134	20
PROJECTILE FRAGMENTATION, 37mm,	**	3	OE Scrap	134	21
GRENADE FRAGMENTATION, HAND, MKII	**	3	OE Scrap	134	21
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	134	21
PROJECTILE FRAGMENTATION, 37mm	**	4	OE Scrap	134	22
PROJECTILE FRAGMENTATION, 37mm	**	3	OE Scrap	134	23
PROJECTILE FRAGMENTATION, 37mm	1	3	OE Scrap	134	24
GRENADE, HAND, PRACTICE, M69, FUZE	1	3	OE Scrap	134	25
HAND GRENADE FRAGMENTATIONATION, MKII	2	3	OE Scrap	134	25
SIGNAL, SMOKE, GROUND, M62 SERIES, TAIL BOOM	1	1	OE Scrap	134	26
PROJECTILE FRAGMENTATIONATION, 37mm	1	1	OE Scrap	134	26
PROJECTILE FRAGMENTATIONATION, 37mm	4	6	OE Scrap	134	27
GRENADE FUZE, PRACTICE, EXPENDED	1	6	OE Scrap	134	27
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	134	28
GRENADE FUZE	1	2	OE Scrap	134	28
FRAGMENTATION	**	4	OE Scrap	191	7
FRAGMENTATION	**	4	OE Scrap	191	8
SIGNAL, ILLUMINATION, GROUND, M127 SERIES, EXPENDED	3	0	OE Scrap	503	265
37mm SCRAP	**	0	OE Scrap	503	266
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	572	12
PROJECTILE, 37mm APC, M51	1	1	OE Scrap	572	14
PROJECTILE, 37mm APC, M51	1	1	OE Scrap	572	15
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	572	16
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	572	43
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	572	44
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	572	45
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	572	51
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	572	57
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	572	72
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	6	OE Scrap	586	6
RIFLE GRENADE, PRACTICE, M11	2	0	OE Scrap	M31h004	28
FUZE, POWDER TRAIN TIME, M1907, FUNCTIONED	1	0	OE Scrap	M31h004	29
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31h004	30
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	0	OE Scrap	M31m006	111
ROCKET, PRACTICE, 35mm, SUBCALIBER, M73, FUNCTIONED	1	0	OE Scrap	M31m006	112
ROCKET, PRACTICE, 3.5in, M29A2	1	0	OE Scrap	M31m006	113
GRENADE, 40mm	1	0	OE Scrap	M31m006	114
MORTAR, 60mm	1	0	OE Scrap	M31m006	115

Table 11-1
List of OE and OE Scrap Items Found in M3-1H Mixed Use Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
PROJECTILE, 37mm APC, M51	1	1	OE Scrap	M31m010	1
PROJECTILE, 37mm APC, M51	1	1	OE Scrap	M31m010	2
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	1
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	2
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	M31m011	3
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	4
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	5
RIFLE, GRENADE, LAUNCHER	1	0	OE Scrap	M31m011	5
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	6
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	7
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	M31m011	8
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	9
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	10
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	11
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	12
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	13
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	14
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	15
ROTATING BAND, 37mm	1	0	OE Scrap	M31m011	16
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	M31m011	17
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	18
MORTAR TAIL BOOM, 60mm	1	0	OE Scrap	M31m011	19
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	20
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	21
PROJECTILE, 37mm APC, M51,	1	0	OE Scrap	M31m011	22
ROCKET, PRACTICE, 2.36in, M7 BALLISTIC ROD	1	0	OE Scrap	M31m011	22
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m011	23
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31m012	47
PROJECTILE, 37mm APC, M51	9	0	OE Scrap	M31m013	1
PROJECTILE, 37mm APC, M51	3	0	OE Scrap	M31m013	2
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	M31m013	3
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	M31m013	4
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	4
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	5
PROJECTILE, 37mm APC, M51	5	0	OE Scrap	M31m013	6
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	6
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	7
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	7
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	8
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	9
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31m013	10
PROJECTILE, 37mm APC, M51	3	0	OE Scrap	M31m013	11
ROCKET, PRACTICE, 2.36in, M7 NOSE CONE	1	0	OE Scrap	M31m013	13
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	M31m013	14
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	16
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	17

Table 11-1
List of OE and OE Scrap Items Found in M3-1H Mixed Use Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	18
PROJECTILE, 37mm APC, M51	2	0	OE Scrap	M31m013	19
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	20
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	21
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	22
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m013	50
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31m015	57
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31m016	58
MORTAR, 60mm, PRACTICE, M69	1	0	OE Scrap	M31m018	5
PROJECTILE, 37mm APC, M51	2	4	OE Scrap	M31m019	1
PROJECTILE, 37mm APC, M51	1	1	OE Scrap	M31m019	3
SIGNAL, ILLUMINATION, GROUND, M127 SERIES, EXPENDED	1	1	OE Scrap	M31m019	4
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m019	59
SIGNAL, SMOKE, GROUND, M62 SERIES, EXPENDED	1	0	OE Scrap	M31m019	60
PROJECTILES, 37mm APC, M51	2	0	OE Scrap	M31m022	52
PROJECTILE FRAGMENTATION, 37mm	**	8	OE Scrap	M31m097	1
PROJECTILE FRAGMENTATION, 37mm	**	0	OE Scrap	M31m097	2
PROJECTILE FRAGMENTATION, 37mm	**	4	OE Scrap	M31m097	3
PROJECTILE FRAGMENTATION, 37mm	**	4	OE Scrap	M31m098	6
PROJECTILE FRAGMENTATION, 37mm	3	0	OE Scrap	M31m098	7
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	M31m098	8
PROJECTILE FRAGMENTATIONS, 37mm	2	0	OE Scrap	M31m098	12
PROJECTILE FRAGMENTATION, 37mm	**	1	OE Scrap	M31m098	13
PROJECTILE FRAGMENTATION, 37mm	**	0	OE Scrap	M31m098	14
PROJECTILE, 37mm APC, M51	1	0	OE Scrap	M31m098	196
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	M31m101	9
PROJECTILE FRAGMENTATION, 37mm	**	4	OE Scrap	M31m101	16
PROJECTILE FRAGMENTATION, 37mm	**	3	OE Scrap	M31m101	21
PROJECTILE FRAGMENTATION, 37mm	**	0	OE Scrap	M31m102	16
PROJECTILE FRAGMENTATION, 37mm	**	0	OE Scrap	M31m102	21
FRAGMENTATION, 37mm	**	2	OE Scrap	M31m103	1
GRENADE FUZE	1	2	OE Scrap	M31m103	1
TAIL BOOMS	**	2	OE Scrap	M31m103	1
TAIL BOOMS	**	0	OE Scrap	M31m103	19
TAIL BOOMS	**	2	OE Scrap	M31m103	26
TAIL BOOM	1	3	OE Scrap	M31m103	38
PROJECTILE FRAGMENTATION, 37mm	**	3	OE Scrap	M31m103	38
ROCKET, 2.36in	1	0	OE Scrap	M31m103	43
TAIL BOOM	1	3	OE Scrap	M31m103	49
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31m103	53
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31m103	54
PROJECTILE FRAGMENTATION, 37mm	**	2	OE Scrap	M31m103	55
ROCKET, PRACTICE, 2.36in, M7	1	1	OE Scrap	M31m103	64
ROCKET, PRACTICE, 2.36in, M7	1	0	OE Scrap	M31m104	55
FRAGMENTATION, 37mm	**	0	OE Scrap	M31m105	197

Table 11-1
List of OE and OE Scrap Items Found in M3-1H Mixed Use Area-D

Item Description	Quantity	Depth (inches)	Target Type	Grid ID/ Transect	Anomaly ID
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	M31m126	2
PROJECTILE, 37mm APC, M51	2	4	OE Scrap	M31m126	3
PROJECTILE, 37mm APC, M51	1	4	OE Scrap	M31m126	4
FLARE BODY	1	0	OE Scrap	M31m126	5
PROJECTILE, 37mm APC, M51	1	4	OE Scrap	M31m126	8
PROJECTILE, 37mm APC, M51	1	3	OE Scrap	M31m126	10
PROJECTILE, 37mm APC, M51	1	3	OE Scrap	M31m126	11
PROJECTILE, 37mm APC, M51	1	8	OE Scrap	M31m126	12
PROJECTILE, 37mm APC, M51	1	3	OE Scrap	M31m126	13
PROJECTILE, 37mm APC, M51	1	6	OE Scrap	M31m126	14
PROJECTILE, 37mm APC, M51	1	6	OE Scrap	M31m126	15
PROJECTILE, 37mm APC, M51	1	4	OE Scrap	M31m126	16
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	M31m127	1
PROJECTILE, 37mm APC, M51	1	2	OE Scrap	M31m127	3
PROJECTILE, 37mm APC, M51	1	3	OE Scrap	M31m127	4

Note: This table does not list small arms finds.

Note: IT# = IT Corporation finds. PBP# = Parsons Burn Pit finds.

*TtEC did not independently verify the accuracy nor currency of information supplied by client or by any of clients contractors, vendors, or consultants.
** Indeterminate amount.

11.3 DESCRIPTION OF HAZARDS OF SPECIFIC OE ENCOUNTERED

UXO items encountered during the site characterization of this OE Risk Assessment Sector include MKI 3in practice Stokes Mortar rounds, MKI 37mm projectiles, 2.36in M6 rockets, from a MKI 75mm shrapnel projectile, and a 81mm M43 mortar round.

11.3.1 The MKI practice 3in Stokes Mortar shell consists of a cylindrical steel casing, having a steel base and steel head screwed on at each end of the casing. The steel head seats the booster jacket and MK VI setback-armed, impact-inertia fired, all-way trench mortar fuze. The steel base seats the cartridge container. Although the practice mortar is filled with 2.1 lbs of sand, the MK VI fuze combined with the booster contain approximately 65 g of black powder. The ignition cartridge contained 45 g of smokeless powder. The fuze safety pin and ring are removed before firing, leaving the set-back pellet supported by friction until the shell leaves the barrel. Upon acceleration the safety fork is ejected and the striker is free to reach the detonating pellet or percussion element upon impact. This fuze has a double percussion element which functions irrespective of the shells position upon impact (all-way). The fuze was painted black and stamped with manufacturer's symbols, and month and year of loading. The shell head was stamped with the name/Mk#, lot #, inspector's stamp, and manufacturer's symbol. The case painted dark blue with white stenciling. The ignition cartridge has a green case with a brass base, the bottom of which is stamped with manufacturer's information andthe item's MK#.

11.3.2 This MKI 37mm projectile is made of bar steel and is filled with .034 ponds of black powder. It weighs approximately 1 ponds. Since it is adapted for a base fuze its nose is continued to a rounded point. The projectile is 3.56 inches long and has a radius of ogive of 2.25 calibers. The fuze is a base percussion MK. I and is constructed of brass. It is an igniting fuze as indicated by "percussion" in the nomenclature. Its explosive train consists of a priming mixture and black powder which ignites the black powder bursting charge. The shell was painted red and stenciled in black. The MK I Sand-loaded (practice) projectile is exactly the same except for the fact that the black powder and live fuze of the L.E. shell were replaced by sand and an inert fuze.

11.3.3 The 2.36in rocket consists of three parts: the high-explosive head, the stabilizer tube, and the fin assembly. This rocket has a 0.5 pound 50/50 pentolite with a 10/90 pentolite booster. The rocket can penetrate three inches of homogenous-steel armor plate at all ranges and at angles of impact as low as 90 degrees. The propellant consists of five sticks of ballistite. The fuze generally consists of a steel firing pin that slips into the central cavity of the fuze body. The fuze body contains the Detonator of M18 of lead azide and a tetryl, and the booster charge of tetryl. It was determined that these items had a high explosive anti-tank (HEAT) or Shape charge with the potential to produce explosive fragments.

11.3.4 The 75mm shrapnel projectile consists of a steel case, near the base of which a shoulder is formed on the interior surface. Three ounces of black powder is packed beneath a diaphragm of steel which rests on the shoulder. This diaphragm also supports a flash tube, the upper end of which is flared out into a smaller thin diaphragm. Between the two diaphragms is held a charge of melted resin which holds 270 lead balls suspended within it weighing 6 ponds, 7 ounces. The top of the case is closed by a steel head finely threaded to the top, and which is adapted to the fuze with a coarse thread. It employs the 21-Second Combination Fuze M1907M which is covered with a metallic moisture proof cap. Either burning of the time element or firing of the percussion element on impact will ignite a black powder charge in the fuze. The flame from the magazine charge of the fuze flashes down the flash tube and ignites the base charge. Explosion of this charge forces the lower diaphragm, matrix and balls, and flash tube upward, blowing off the fuze and head as a unit. The resin matrix is ignited and the lead balls are ejected. The lead bells have a velocity of 350 feet/second in addition to the velocity of the projectile at the time of bursting. It was painted red and stenciled in black.

11.3.5 The 81mm M43 mortar round consists of a projectile body, a point-detonating fuze, a fin assembly, a propellant charge, and an ignition charge with a percussion primer. The projectile body is filled with Composition B high explosive. The point detonation (PD) fuze functions on impact detonating the fuze booster charge and, in turn, high explosive charge.

11.4 RISK ASSESSMENT

Figure 11-1, located at the end of this chapter, presents the CSM for potential exposures to OE in OE Risk Assessment Sector M3-1H-Mixed Use Area-D in Redevelopment Parcel M3. The primary sources include various firing points and range safety fans and a combat range/training area located within the sector. OE may be present in the range safety fans as a result of firing. At the firing points, ordnance may have been released due to mishandling, poor housekeeping, or loss. OE may be present in the combat range/training area as a result of firing or poor housekeeping, mishandling, or loss. These releases likely result in OE being present on the ground surface or in the subsurface soils of the sector. Additionally, there was the potential for

release to the limited surface water or sediments in this area. This CSM also indicates the principal mechanisms by which ordnance items may migrate from one location to another in the sector, shift from one depth in the soil to another, or migrate from one medium to another. These potential transport and migration mechanisms include mechanical redistribution, human activity, precipitation run-off, and (in limited, specific locations) erosion and frost heave. The original deposition of the ordnance items and the localized transport and migration processes result in a new distribution of OE items in the soil, surface water, or sediments which may be locations of direct contact exposure by current or reasonably foreseeable future receptors associated with reuse of the area. Potential direct contact with the surface water and sediments (as possible exposure media) is indicated, but OE presence in these media has not been confirmed (represented as a dashed box in Figure 11-1, located at the end of this chapter). Receptors may include commercial or industrial workers, and construction workers associated with the redevelopment and land re-use. Terrestrial and aquatic wildlife may also be exposed to ordnance items present in the sector.

11.5 COMPARATIVE ANALYSIS OF RESPONSE ACTION ALTERNATIVES

11.5.1 Effectiveness

The OERIA risk assessment process addresses the combined criteria of overall protectiveness to human health and the environment and long-term effectiveness and permanence. The results of the risk assessment performed for the M3-1H-Mixed Use Area-D sector using this process are presented in Figure 11-2, located at the end of this chapter. Based on these results, the most effective alternatives for the protection of human health and the environment were judged to be the removal alternatives. Alternative 6-Clearance to Depth was projected to provide the highest level of protectiveness throughout the sector, while Alternative 5-Clearance to 1 Foot Depth was judged to provide a lower level of protectiveness due to the indicated depth of OE in this area relative to the indicated future use for development. OE was found in this sector on the surface and within the first thirteen inches below the ground surface. OE Scrap was found in this sector on the surface and within one foot of the ground surface. Alternative 4-Surface Clearance received a low ranking because it would not be expected to remove OE from depths where it is indicated to be present and where future users of the area may disturb. Alternative 3-Construction Support is considered to be protective, but only within the future construction footprints within the sector where clearance of OE would be selectively performed. Alternative 2-Area-Specific Land Use Controls was considered to be less effective than any of the removal alternatives except for the case when Surface Clearance would be performed alone. Alternative 1-No Further Action was considered to be the least effective. Since development / redevelopment activities are planned for this sector, Alternative 6 would provide the highest level of protectiveness, followed by Alternative 5.

11.5.1.1 With respect to the other effectiveness criteria, Alternative 1 - No Further Action, clearly has the least short-term impacts since No Further Action is being taken that might affect on local workers or the public. Alternative 2 - Area-Specific Land Use Controls, also presents little short-term effects since the only activity that might have impact on the workers or the public involves installation of a limited number of warning signs. The removal alternatives (Alternatives 3, 4, 5, and 6) have the greatest potential impact on the workers and public since each involves the potential of more direct contact with OE. Overall, Alternative 1 will have the

least short-term impacts, followed by Alternatives 2 and 3, and then Alternatives 4, 5, and 6. Among the latter three alternatives, the short-term impacts will generally increase from Alternatives 4 to 6, since each has a potential for longer and more intense exposure to OE. With respect to the compliance with ARARs criterion, each alternative will comply.

11.5.2 Implementability

11.5.2.1 Technical Feasibility

All six alternatives are technically feasible with Alternative 1 being the most technically feasible since there is No Further Action required at the site (i.e., investigation or removal actions). Alternative 2 is the second most technically feasible alternative. It requires that technical actions be taken at the site (i.e., installation of signage at the site). The remaining alternatives are each technically feasible but less so than Alternatives 1 and 2, because they each involve more intense site activities and dependence on technology. In summary, Alternative 1 will be the most technically feasible, Alternative 2 next, followed by Alternatives 3, 4, 5, and 6.

11.5.2.2 Administrative Feasibility

All six alternatives will require the preparation and DDESB-approval of an ESS document. Alternatives 3 through 6 will each require the preparation and approval of a work plan since each alternative involves onsite OE activities. Alternatives 2, 3, 4, and 5 will also require compliance with the LUCAP for Fort McClellan, since each involves the implementation of land use controls. In summary, considering these requirements, Alternative 1 will be the simplest to administer, with Alternative 6 next, and Alternatives 2, 3, 4, and 5 being the most difficult of the alternatives to administer due to the inclusion of land use controls and the requirements to comply with the LUCAP.

11.5.2.3 Availability of Services and Materials

Services and materials will be required and are readily available for preparing the plans mentioned above and to complete the fieldwork associated with Alternatives 3 through 6. Based on the levels of services needed, Alternative 1 will require the least services and materials since it only requires effort to prepare the ESS. More services and materials will be required for the implementation of Alternative 2 since it requires the preparation of the ESS, installation of signs, as well as coordination with the LUCAP. Even more services and materials will be required for Alternative 3 since it requires a work plan to support construction support activities and the field service activities to provide the actual construction support. Alternative 4 will be similar in scope of required services and materials. Alternatives 5 and 6 will require the most in services and materials. In summary, Alternative 1 will require the least in services and materials to implement, with Alternative 2 next. Alternatives 3 and 4 will require a higher level of services and materials than Alternatives 1 and 2, but less than Alternatives 5 and 6.

11.5.2.4 Regulatory and Community Acceptance

The level of regulatory and/or community acceptance for each alternative can be expected to largely depend on the protection that each alternative offers. OE was detected on the surface and

at depths extending below one foot and a large amount of OE Scrap was found on the surface and below ground surface in this sector. The future land use is projected to be Development. Alternative 1-No Further Action does nothing to provide any degree of protection and therefore is unlikely to be accepted by the regulatory community or the public. Alternative 2-Area-Specific Land Use Controls would probably not be received favorably since it will provide only limited protection to members of the public involved in intrusive activities (i.e., excavations, etc.). Alternative 3-Construction Support may be received favorably since it provides protection to construction workers and to the public in that it also includes the land use controls of Alternative 2. Alternative 4-Surface Clearance may be expected to receive a similar level of acceptance as Alternative 3. It includes removal of potential OE from the surface (not subsurface) across the entire sector, not just within construction footprints and is accompanied by land use controls. However, the belief that significant numbers of subsurface OE may be present may lead to a reduced acceptance of this alternative. Alternative 5-Clearance to One Foot Depth and Alternative 6-Clearance to Depth may receive the highest level of acceptance by both regulators and the public since they both involve a subsurface removal of potential OE in an area expected to experience development.

11.5.2.4.1 In summary, the alternatives that may be best received by the regulators and/or public would be Alternative 5-Clearance to One Foot Depth and Alternative 6-Clearance to Depth, followed in order by Alternative 4-Surface Clearance, Alternative 3-Construction Support, Alternative 2-Area-Specific Land Use Controls, and lastly, Alternative 1-No Further Action.

11.5.3 Cost

The projected costs to implement the alternatives in this 169-acre sector are summarized below:

- Alternative 1 - No Further Action – $5,000. An ESS (preparation, draft, and final) will be prepared for a group of sectors. This is an approximation of one sector's portion of the total cost.

- Alternative 2 - Area-Specific Land Use Controls – $17,000. This cost includes planning and installation of signage. No annual maintenance costs are included.

- Alternative 3 - Construction Support – $667,470. This estimate includes management, planning, and UXO support.

- Alternative 4 - Surface Clearance – $1,489,741. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 5 - Clearance to One-Foot Depth – $3,299,406. This cost includes management and planning, OE removal activities, and reporting.

- Alternative 6 - Clearance to Depth – $3,480,809. This cost includes management and planning, OE removal activities, and reporting.

11.6 RECOMMENDATION

The recommended alternative for M3-1H-Mixed Use Area-D is Alternative 6-Clearance to Depth. Components of this alternative will include land surveying and brush clearing operations to prepare the site. Due to the requirement to detect items potentially deeper than one foot, this alternative will be performed using sensitive instruments capable of detecting anomalies at greater depths. Using a suitably sensitive detection system, the entire study area will be surveyed to locate potential OE items. The anomalies will then be investigated to identify them as UXO, OE Scrap, or Non-OE Scrap (metallic scrap). After identification, the items will be disposed of as scrap or OE in accordance with the previously-approved OE operations work plan.

11.6.1 Planning for this response action will require preparation of an ESS and a site-specific removal action work plan. The estimated cost to implement this alternative is $3,480,809.

11.7 SUPPORTING RATIONALE

The risk analysis and the comparative analysis indicated that clearance to depth should provide sufficient protection for this sector. During the sampling conducted in this sector as part of the Bravo EE/CA sampling no UXO or OE Scrap was found deeper than 13 inches. Several UXO items were found on the surface and to a maximum depth of 13 inches. OE Scrap items were found to a depth of 12 inches in this sector. Four UXO items were found previously on the surface by IT Corporation.

THIS PAGE INTENTIONALLY LEFT BLANK.

Figure 11-1
M3-1H-Mixed Used Area-D
CONCEPTUAL SITE MODEL

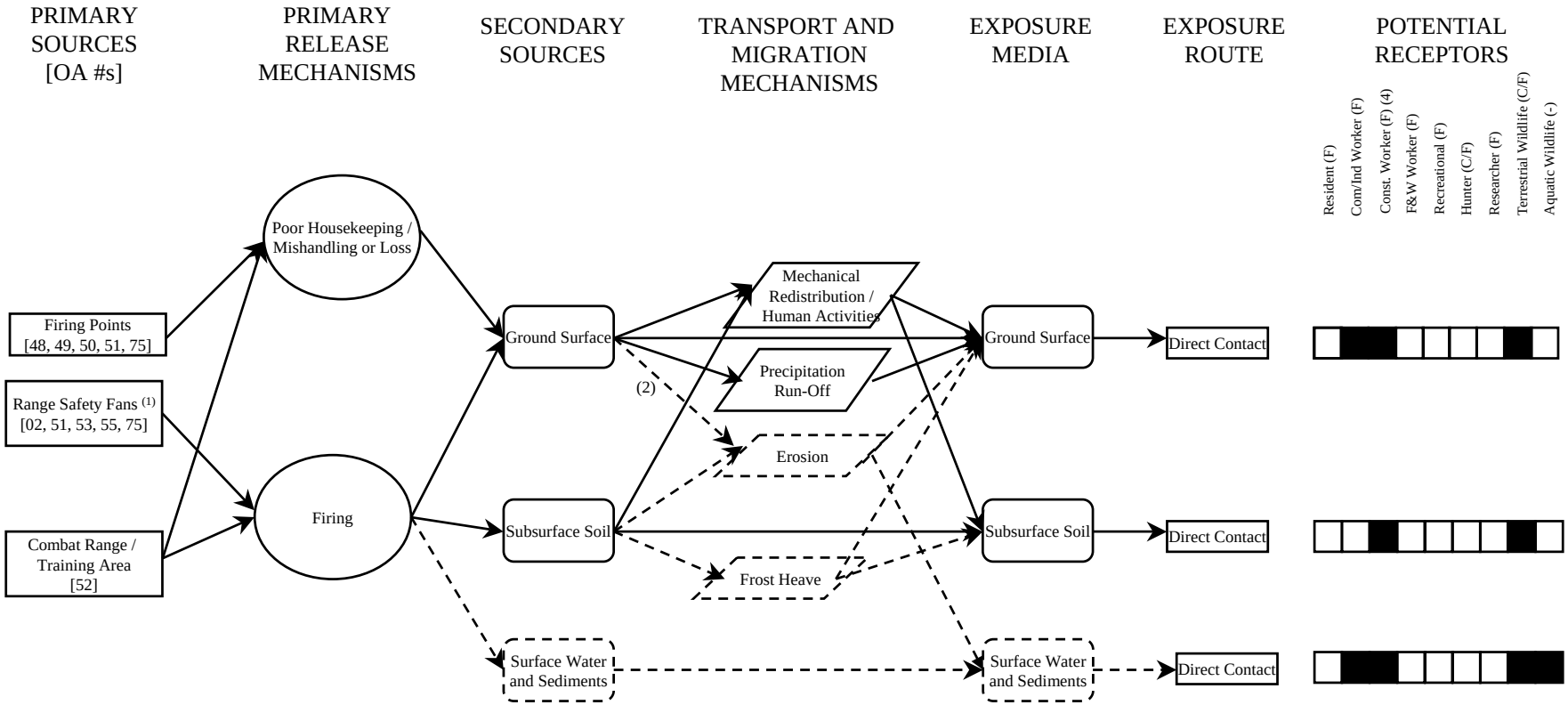


PLATE NOS. (3)	OA#	NAME (Other Names)	ORDANCE AND EXPLOSIVES ASSOCIATED WITH AREA
4, 10	52	Combat Range #2 (a.k.a. Rocket Range; Machine Gun Range; 2 Rifle Grenade Ranges)	Rockets; Small Arms; Rifle Grenades
5, 10	02	Machine Gun Range	Small Arms
5, 10	51	2 Rifle Grenade Ranges	Rifle Grenades (WWII era)
5, 6, 10	53	60mm Mortar Range	60mm HE Mortars
5, 6, 10	55	Old Range 12 (Range 12; Rifle Field Firing)	Small Arms
6, 7, 10	48	Range 12 (a.k.a. Range 14)	Small Arms; Light Anti-Tank Weapon; Anti-Tank; 60mm Projectiles; Rockets
6, 7, 10	49	Range 13	Small Arms; Light Anti-Tank Weapon
6, 7, 10	50	Range 19	Small Arms
7, 10	75	Skeet Range	Various Gauge Shotguns

NOTES:
(1) For non-Small Arms munitions.
(2) Dashed boxes or lines indicate a potential source area or linkage that requires further verification or is a linkage that is indicated to be present in only a small number of specific locations.
(3) Plate numbers obtained from the Fort McClellan Archives Search Report
(4) Within footprint of potential future development activity
C = Current Receptor
F = Potential Future Receptor
- = Not plausible for this sector

Figure 11-2 **OERIA TABLE FOR SECTOR M3-1H-MIXED USE AREA-D**

AREA: **BRAVO**
SECTOR: **M3-1H-Mixed Use Area-D**
TOTAL SECTOR AREA: **169 acres**
AREA GEOPHSICALLY SURVEYED: **9.33 acres [3]**
AREA INTRUSIVELY INVESTIGATED: **1.71 acres (equivalent) [4]**

	ORDNANCE								SITE		HUMAN CURRENT USE			HUMAN FUTURE USE				OVERALL RANK	
	HE Items Found? [Yes]	OE Type [7]		OE Sensitivity [7]		OE Item Depth Distribution		OE Item Density	OE Site Access	OE Site Stability	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Activity	OE Contact Probability Level	Exposed Population *(Number or Freq. Of Use)*	Likelihood of Near Term Reuse	CURRENT LAND USE	FUTURE LAND USE
	HE Debris Found? [Yes]		(%)		(%)	Depth Range	% [9]	(Items/Acre) [8,9,12]											
Baseline Risk Assessment (Existing Conditions)		Cat. 3	55	Cat. 3	55	Surface	72.7 / *{55.7}*	1.71 / *{11.6}*	No Restriction to Site	Site Stable	Recreational [13,17]	Significant [18]	Occassional [19]	Development [16,33]	Significant [18]	Frequent	High		
		Cat. 2	5	Cat. 2	5	0 to 1' bgs	22.7 / *{44.3}*	2.92 / *{50.3}*											
		Cat. 1	41	Cat. 1	41	1' to Depth	4.55 / *{ - }*	0.58 / *{ - }*											
		Cat. 0	*	Cat. 0	*	Overall [11]		12.9 / *{113}*											
						90% CI on Overall OE Item Density [10]		9.21 - 18.3											
Alternative 1 - No Further Action		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	No Impact		No Impact	No Impact		BASELINE	BASELINE
Alternative 2 - Land Use Controls		No Impact		No Impact		No Impact			No Impact	No Impact		No Impact	B		No Impact	B		LOW	LOW
Alternative 3 - Construction Support		No Impact		No Impact		A [21]			No Impact	No Impact		A [21]	A [21]		A [21]	A [21]		MODERATE [20]	MODERATE [20]
Alternative 4 - Surface Clearance		No Impact		No Impact		C			No Impact	No Impact		B	A [23]		C	A [23]		LOW	LOW
Alternative 5 - Clearance to 1 Foot Depth		No Impact		No Impact		B			No Impact	No Impact		A	A [22]		B	A [22]		HIGH	MODERATE [37]
Alternative 6 - Clearance to Depth		A		A		A			No Impact	No Impact		A	A [22]		A	A [22]		HIGH	HIGH

NOTES

3 The Geophysically Surveyed Area includes the area associated with the transects within this specific sector.
4 Based on the fraction of identified target anomalies intrusively investigated in each geophysically surveyed grid and/or transect segment.
7 Percentages classify OE items found. If no OE items are found, Category 0 is 100% and Categories 1 - 3 are noted with a "*". If OE items are found, Category 0 is noted with a "*".
8 OE Density values shown are the straight average value = # of OE Items / Acres in which they were found.
9 Densities and depth range percentages shown in italics and curley brackets indicate characteristics of the OE debris.
10 The OE Density range shown represents a 90% confidence interval on the OE Item density calculated using UXO Calculator Version 1.4.2.
11 Overall OE item density is based on all OE Items found in the area intrusively investigated.
12 The surface OE item density is based on the area geophysically surveyed and the 0-1' and 1'-Depth OE item densities are based on the area intrusively investigated.
13 Specific activities identified for the recreational current land use include hunting, hiking, and short cuts.
16 Development land use was assumed to be associated with routine interaction with the surface and near-surface soils by the employees of the new facilities. In addition, the construction of new facilities, structures, or underground utilities and the maintenance or replacement of existing structures or utilities was assumed to be reasonably associated with this land use.
17 Exposure to terrestrial wildlife is also assumed.
18 Based on the depth of intrusion associated with the identified activities - See Table 5 of USACE OERIA Interim Guidance (3/27/01).
19 The frequency of site usage is currently classified as rare and the number of site users is currently classified as low due to restrictions that have been placed on the site (i.e., no hunting or hiking) since the remediation activities began. The current frequency of usage would be classified as occassional if these recreational activities took place.
20 Indicated to be the most protective alternative within the construction footprint.
21 Risk factor score indicated applies only within the construction footprint.
22 No increased protectiveness relative to alternatives with a shallower clearance depth due to the depth distribution of OE items found.
23 Removal of surface OE items or debris may reduce the number of potential exposures to souvenir hunters.
33 Future Development activities are projected to be associated with Development Reserve Use.
37 Protectiveness may be greater given the effect of the deed restriction prohibiting digging.
- = Not applicable as no energetic OE items were found.

IMPACT CODE

A = Signifiies the greatest impact on reducing potential exposures to OE; Relatively less impact as the letter ranking goes to B, C, and subsequent letters.
HIGH - Most protective relative to projected land use.
LOW - Least protective relative to projected land use.
MODERATE - Protectiveness level between Low and High.
BASELINE - Protectiveness level associated with Alternative 1 - No Further Action.