STAKEHOLDER DRAFT FINAL

Military Munitions Response Program

Land Use Controls

Interim Measures Work Plan for

Anti-Aircraft Range 90-MM – 2 (FTSW-002-R-01)
Small Arms Range – 2 (FTSW-006-R-01)
Hero Road Trench Area (FTSW-008-R-01)
Anti-Aircraft Range – 4-A (FTSW-009-R-01)
Anti-Aircraft Range – 4-B (FTSW-009-R-02)
Anti-Tank Range 90-MM – 2 (FTSW-010-R-01)
Grenade Launcher Range (FTSW-011-R-01)

Fort Stewart, Georgia

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Acronyms

Acronym	Definition
CA	Corrective Action
CAIS	Chemical Agent Identification Set
CMS	Corrective Measures Study
CS	Confirmatory Sampling
DERP	Defense Environmental Restoration Program
DMM	Discarded Military Munitions
DoD	Department of Defense
DPW	Directorate of Public Works
EOD	Explosive Ordnance Disposal
ESV	Ecological Screening Value
GA	Georgia
GAEPD	Georgia Environmental Protection Division
GIS	Geographical Information System
IBCT	Infantry Brigade Combat Team
IMCOM	Installation Management Command
LUC	Land Use Control
LUR	Land Use Restriction
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
mm	millimeter
MMRP	Military Munitions Response Program
MRA	Munitions Response Area
MRS	Munitions Response Site
NCP	National Contingency Plan
NPV	Net Present Value
ODUSD(ES)	Office of the Deputy Under Secretary of Defense (Environmental Security)
O&M	Operations and Maintenance
OSWER	Office of Solid Waste and Emergency Response

Acronym	Definition
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSL	Regional Screening Level
TCRA	Time Critical Removal Action
U.S.	United States
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance

Executive Summary

The United States (U.S.) Army is establishing land use controls (LUCs) at installations within the Military Munitions Response Program (MMRP) to protect human health from potential hazards at Munitions Response Sites (MRSs) as an interim action while the sites progress to a final remedy. The MMRP addresses Munitions and Explosives of Concern (MEC) and Munitions Constituents (MC) within the framework of the Resource Conservation and Recovery Act (RCRA) Corrective Action (CA) process. The LUCs are intended to limit the risk posed by the MEC and MC at the MRSs while the further investigation and response actions are being implemented under RCRA. The LUCs considered under this phase of the MMRP are interim measures consistent with RCRA. No action will be taken with this interim measures to remove or remediate the MEC and MC at the seven MRSs. Therefore, residual risk from the MEC and MC will remain on site. These interim LUCs are not intended to be permanent or to replace the need for the more permanent solutions developed under the MMRP process, as appropriate.

Fort Stewart is conducting its MMRP at seven MRSs where further actions are pending and are evaluated as part of this abbreviated Interim Measures Work Plan. A detailed review of the MRSs was made during the initial Confirmatory Sampling (CS) phase conducted by Malcolm Pirnie in 2007, which identified two MRSs (FTSW-002-R-01 and FTSW-008-R-01) as eligible for the MMRP. Fort Stewart recently expanded the cantonment area, where approximately 4,240 acres was re-designated as other than operational. A Phase 2 CS Report (ARCADIS/Malcolm Pirnie, 2011) was conducted on the 4,240-acre re-designated parcel as a continuation of the initial 2007 CS and identified five MRSs (FTSW-006-R-01; FTSW-009-R-01; FTSW-009-R-02; FTSW-010-R-01; and FTSW-011-R-01). The 2007 and 2011 CS reports are the basis for the site history provided in this report and in Table ES-1, which lists the seven on-post MRSs eligible for interim LUCs.

Table ES-1: On-Post MRSs Recommended for Further Action

MRS Name	AEDB-R No.	Acres	MEC Present?	MC Present?	MRSPP Score(1)
Anti-Aircraft Range 90-MM – 2	FTSW-002-R-01	77	Yes	Potential	4
Small Arms Range – 2	FTSW-006-R-01	287	Yes	Potential	4
Hero Road Trench Area	FTSW-008-R-01	34.5	Yes	Potential	6
Anti-Aircraft Range – 4-A	FTSW-009-R-01	465	Yes	Potential	3
Anti-Aircraft Range – 4-B	FTSW-009-R-02	663	Yes	Potential	3
Anti-Tank Range 90-MM – 2	FTSW-010-R-01	546	Yes	Potential	5
Grenade Launcher Range	FTSW-011-R-01	132	Yes	Potential	4

(1) The Munitions Response Site Prioritization Protocol (MRSPP) Rating is on a scale of 1 to 8, with 1 being the most hazardous. The MRSPP estimates, from the CS, are used as an indicator of the relative risks of MRSs at Fort Stewart.

This work plan has a focused purpose and is not intended to result in a final remedy at the Fort Stewart MRSs. Following the Interim Measures Work Plan, the Army will finalize a LUC Plan to guide the implementation of LUCs as an interim measure. The LUCs recommended for Fort Stewart involve a combination of institutional controls (including land use restrictions, notations in the Installation Master Plan, and dig permits with UXO construction support for areas known or have the potential to have MEC) and engineering controls (including signs/markers and fencing). The institutional control measures are considered and applied to all MRSs at Fort Stewart. Three MRSs (FTSW-002-R-01; FTSW-008-R-01, and FTSW-009-R-02) also have engineering controls applied to include signage and/or fencing.

Interim LUCs will incur capital and operating costs in the short term while the full response action is developed and implemented for each MRS in the MMRP. This includes maintenance of existing LUCs that are in place at Fort Stewart. It is estimated that it will be approximately four years before investigations and corrective measures implementation (construction) phases are completed at the seven on-post MRSs, which are eligible for LUCs as an interim action. Capital Costs for LUCs is estimated at approximately $54,800 with annual operating costs of approximately $66,500.

1 Introduction

The United States (U.S.) Army is establishing land use controls (LUCs) at installations within the Military Munitions Response Program (MMRP) to protect human health from potential hazards at Munitions Response Sites (MRSs) as an interim measure while the sites progress to a final remedy. The MMRP addresses Munitions and Explosives of Concern (MEC) and Munitions Constituents (MC) within the framework of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, 42 U.S.C §§ 9601 et seq.). While it is the Department of Defense's (DoD's) goal to address MRSs under CERCLA, the Army recognizes that some installations (including Fort Stewart) may be requested to address their sites under the Resource Conservation and Recovery Act (RCRA) Corrective Action program. For this reason, this Interim Measures Work Plan uses the RCRA phase designations. The LUCs considered under this phase of the MMRP are interim measures consistent with RCRA.

Fort Stewart is conducting its MMRP and has seven on-post MRSs where further actions are pending. These MRSs are eligible for LUCs as an interim measure while their RCRA responses continue.

This Interim Measures Work Plan is a required step in implementing the LUCs as an interim measure at Fort Stewart. This is an abbreviated Work Plan that summarizes MRS information and presents appropriate LUCs to be implemented at each MRS. The Work Plan has a focused purpose and is not intended to result in a final remedy at Fort Stewart.

Following the Interim Measures Work Plan, the Army will finalize a Land Use Control Plan to guide the implementation of LUCs as an interim measure.

The following MRSs at Fort Stewart are eligible for LUCs as interim measures and are addressed in this Work Plan:

- Anti-Aircraft Range 90-MM – 2 (FTSW-002-R-01)
- Small Arms Range – 2 (FTSW-006-R-01)
- Hero Road Trench Area (FTSW-008-R-01)
- Anti-Aircraft Range – 4-A (FTSW-009-R-01)
- Anti-Aircraft Range – 4-B (FTSW-009-R-02)
- Anti-Tank Range 90-MM – 2 (FTSW-010-R-01)
- Grenade Launcher Range (FTSW-011-R-01)

1.1 Regulatory Framework/Authorization

The MMRP is conducted under the Defense Environmental Restoration Program (DERP) to address DoD sites with unexploded ordnance (UXO), discarded military munitions (DMM), and MC located on current and former military installations. Due to the potential hazards posed by the possible presence of MEC (which include UXO, DMM, and MC in sufficiently high

concentrations to pose an explosive hazard); there is the potential for harm if appropriate controls are not maintained.

To address the explosive hazards and the risks from MEC and MC at active installations and to meet the requirements in the *FY2010 Program Management Plan for the Active Sites Cleanup Program*, the U.S. Army Environmental Command (USAEC) is assisting installations in preparing and implementing LUCs for their on-post MRSs. Only Army-owned MRSs with ongoing and/or future cleanup requirements are eligible for inclusion in this program.

1.1.1 CERCLA/RCRA and the National Contingency Plan (NCP)

In carrying out the MMRP, it is Army policy to conduct all actions according to lead agency authority under CERCLA and E.O. 12580. According to the U.S. Environmental Protection Agency (USEPA) Munitions Response Guidelines (Office of Solid Waste and Emergency Response [OSWER] Directive 9200.1-101), CERCLA is the preferred authority for conducting MMRP responses and "where DoD is conducting response actions under its DERP, those response actions must be consistent with CERCLA and the NCP. The guidelines further state that the use of RCRA is only applicable in situations where there is an imminent and substantial threat to human health or the environment and which requires immediate and expeditious action to eliminate the threat. For installations that have a RCRA permit, which includes corrective action requirements, the use of CERCLA for the investigation and remediation of these MMRP sites should be considered to also meet all RCRA corrective action requirements. USEPA has issued a number of policy and guidance documents that state that environmental response actions conducted under either RCRA corrective action or CERCLA and the NCP substantively satisfy the other program's requirements, and the regulated community will not be required to conduct duplicative response actions to satisfy procedural or formatting requirements of the two programs. *See* "Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities", USEPA Office of Enforcement and Compliance Assurance (OECA) and OSWER (Sept. 24, 1996); "Improving RCRA/CERCLA Coordination at Federal Facilities", USEPA OSWER Directive No. 9272.0-22 (Dec. 21, 2005); and "Lead Regulator Policy for Cleanup Activities at Federal Facilities on the National Priorities List", USEPA OSWER Federal Facilities Restoration and Reuse Office (FFRRO), (Nov. 6, 1997).

1.2 Purpose and Scope of the Work Plan

This Work Plan identifies LUCs to be implemented for the mitigation of potential risk to human health as interim measures on eligible MRSs at Fort Stewart. Sites with a no further action recommendation and MRSs located off Army-owned land are not addressed in this Work Plan, although they are being addressed, as appropriate, under the MMRP.

1.3 Interim Measures Objectives

The objective of the interim measures is to protect human health by minimizing exposure to MEC and MC through the implementation of LUCs at on-post MRSs while further response actions at the sites are evaluated and implemented.

The interim measures LUCs are intended to reduce the probability of direct contact with MEC or MC, and will thus reduce the exposure and explosive risk to humans that may be present at the MRSs. However, no action will be taken with these interim measures to remove or remediate the MEC and MC at the Fort Stewart MRSs. Therefore, residual risk from the MEC and MC will remain. These interim LUCs are not intended to be permanent or to replace the need for the more permanent solutions developed under the MMRP.

1.4 Work Plan Organization

This Work Plan is organized as follows:

- Section 1 – Introduction
- Section 2 – Management Approach
- Section 3 – Technical Approach
- Section 4 – Costs
- Section 5 – Schedule

The following appendices are included as part of this Work Plan:

- Appendix A – References
- Appendix B – Cost Breakdown and Assumptions

2 Management Approach

This abbreviated Interim Measures Work Plan only addresses LUCs recommended to be established as interim measures at eligible Fort Stewart MRSs and does not address the specific managerial actions necessary to implement the establishment of any LUCs. Specific actions and the management approach taken to ensure that the recommended LUCs are implemented will be addressed prior to the establishment of the recommended LUCs.

3 Technical Approach

This Interim Measures Work Plan outlines recommended LUCs to be established at eligible MRSs at Fort Stewart. No field work was conducted for the preparation of this Work Plan and all information included was obtained through review of applicable reports and studies, such as the Final Confirmatory Sampling (CS) Report (Malcolm Pirnie, 2007) and the Final Phase 2 CS Report (ARCADIS/Malcolm Pirnie, 2011). The recommended LUCs selected for each MRS were determined by evaluating a combination of historic munitions use, available MEC and MC data, current security and land use restrictions (LURs), current land use and potential human receptors, and reasonably anticipated future land use and potential human receptors.

3.1 Technical Planning Process

The Technical Project Planning (TPP) process[1] has been used to date in the MMRP activities at Fort Stewart. The TPP will be used to establish LUCs as interim measures to develop project objectives and communicate with stakeholders. A TPP meeting was held on 24 August 2011 with representatives from the Army and the Georgia Environmental Protection Division (GAEPD) to discuss the LUC Interim Measures project, its purpose, schedule, and probable conclusions. Agreements from the minutes from that meeting are reflected in this document.

3.2 Previous Investigations

The MRSs at Fort Stewart have been the subject of the following reports:

- The *Final Phase I Historical Records Review, Fort Stewart, Georgia* (September 2006) presents detailed descriptions of the previous investigation conducted at Fort Stewart.
- The *Final Confirmatory Sampling, Fort Stewart, Georgia* (November 2007) provided background information for the areas surrounding the MRSs at Fort Stewart.
- The *Final Preliminary Assessment for the Small Arms Range – 2, Fort Stewart, Georgia* (January 2009) determined that the Small Arms Range – 2 was eligible for the MMRP.
- The *Final Phase 2 Historical Records Review, Fort Stewart, Georgia* (June 2010) identified four additional MRSs eligible for the MMRP.

[1] The four-phase TPP process is described in *EM 200-1-2 (Engineering Manual 200-1-2: Technical Project Planning Process*, U.S. Army Corps of Engineers [USACE], August 1998). The TPP team involves key decision-makers, including installation representatives, the USACE project manager, regulators, and other stakeholders. Their participation helps define the information needed to make decisions at the MRS, keeps them informed, and allows better buy-in to the process.

- The *Final Phase 2 Confirmation Sampling, Fort Stewart, Georgia* (September 2011), a continuation of the initial 2007 CS Report, focused on evaluating the potential presence of historical munitions use on the 4,240-acre re-designated parcel, where additional MRSs are eligible.

Following the CS fieldwork, two MEC investigations were conducted by U.S. Army Corps of Engineers (USACE), Baltimore District Explosive Safety due to explosive ordnance disposal (EOD) responses within the 4th Infantry Brigade Combat Team (IBCT) construction site within the footprint of Anti-Aircraft Range-4. These investigations are described in Section 3.4.4.

Additional data on the MRSs at Fort Stewart and its surrounding can be found in the following document:

- The *Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia, Volume I of III* (April 2000) provided background concentrations for metals at Fort Stewart.

These documents and policy and regulatory guides are listed in Appendix A.

3.3 Installation Description

Fort Stewart consists of 279,081 acres and is located north of Hinesville, Georgia (GA), approximately 40 miles southwest of Savannah, GA. Figure 3-1 shows the location of the installation within GA. Fort Stewart is the largest Army installation east of the Mississippi River, spanning portions of Bryan, Evans, Liberty, Long, and Tattnall counties. GA Highway 119, which runs north to south from Pembroke to Hinesville, and GA Highway 144, which runs east to west from Richmond Hill to Glennville, bisect Fort Stewart. Situated south of Interstate 16 and west of Interstate 95, the installation boundaries are roughly defined by the intersection of Interstate 16 and Interstate 95 and the cities of Richmond Hill, Hinesville, Glennville, Claxton, and Pembroke.

3.4 MRS Descriptions

The seven MRSs considered in this Interim Measures Work Plan are described below. Their locations are shown in Figure 3-2.

3.4.1 Anti-Aircraft Range 90-MM – 2 (FTSW-002-R-01)

This MRS is a 77-acre parcel, located northwest of the cantonment area, where two different types of historical munitions uses occurred. These uses included anti-aircraft and tank training and occurred on a total of six separate/collocated ranges from 1941 through 1964. The MRS is positioned in the downrange portion of these ranges and does not overlap impact/target areas or firing points. The known munitions associated with this MRS include 40-millimeter (mm) and 90-mm anti-aircraft projectiles. The munitions used on the tank range are unknown. However,

archival documents from 1941 indicate that 37-, 40-, and 90-mm HE and 37-, 40-, and 90-mm practice rounds with tracers were issued to Fort Stewart. Therefore, it is assumed that these munitions could have been used on this MRS. Numerous EOD calls involving C-4 plastic explosives (secondary explosives), M-222 Dragon HE anti-tank guided missiles, M-7 grenades (riot control agent), and MK-2 fragmentation hand grenades were reported on this site. This MRS is shown in Figure 3-3.

3.4.1.1 MEC and MC

A limited magnetometer assisted visual survey, consisting of a five-foot wide path to the sample location, was conducted during the Phase 1 CS. No MEC or munitions debris was observed along the path to the sample location. It is unlikely for MEC to be present on the surface of the developed portion of the MRS as the site is currently an ammunition supply point and is well maintained (mowed). However, based on historical evidence, MEC may be present in the undeveloped portions of the site.

One composite surface soil sample was collected and analyzed for aluminum, copper, zinc, lead, antimony, and explosives. Based on the results of the metals analysis, the sample exceeded the Region 4 ecological screening value for lead in surface soil, but was within the Fort Stewart established background value for lead. No other metals were detected in concentrations exceeding regulatory screening values. No explosive compounds were detected above laboratory detection or method reporting limits.

This site was recommended for RCRA Facility Investigation (RFI)/Corrective Measures Study (CMS) for potential MEC/MC due to historical evidence of multiple overlapping range fans and multiple EOD responses.

3.4.1.2 Current and Future Anticipated Land Use

There are 42 buildings and one ammunition supply point on the MRS. There is no known change in land use at this time; the potential future land use is assumed to be the same as the current land use (ammunition supply point).

3.4.1.3 Existing Engineering or Institutional Controls

The MRS is entirely fenced. Access to the ammunition supply point is also guarded.

3.4.2 Small Arms Range – 2 (FTSW-006-R-01)

This 287-acre MRS is located along the western perimeter of the cantonment area and historically was used for small arms training during the 1940s and 1950s. The combined acreage of the overlapping range fans is 2,091 acres, 287 acres of which overlap the other than operational area and make up Small Arms Range – 2. The MRS is composed of the firing points of the four small arms ranges and the downrange area of Range M and HBANM Ranges. According to the Phase 2 CS, munitions used on the small arms range were .50-cal or less; however, the exact calibers are unknown. Archival documents from 1941 document the use of .30-cal and .50-cal machine guns on Fort Stewart. Therefore, it is assumed that .30-cal and .50-cal small arms were used on this MRS. Two documented EOD responses were identified at the

site. The first involved a 105-mm projectile and occurred in April 2003. The second occurred in 2008; however, the munitions item encountered was not documented. This MRS is shown in Figure 3-4.

The berm of a former small arms range, identified as the "Fire Station 5 Berm" due to its proximity to a fire station, was identified within the Small Arms Range – 2 MRS boundary. The USACE Savannah District conducted an investigation of this berm. During this investigation, soil samples were collected from the Fire Station 5 Berm on the August 7 and 8, 2008. In total, 22 samples were collected and analyzed for antimony, copper, and lead. Concentrations of antimony ranged from below the method detection limit to 2.38 mg/kg. Concentrations of copper ranged from 0.247 to 104 mg/kg. Concentrations of lead ranged from 2.19 to 1,000 mg/kg. Three samples exceeded the 400 mg/kg USEPA Region 9 Preliminary Remediation Goals, now referred to as Regional Screening Levels (RSLs), for lead.

A Supplemental Investigation and time critical removal action (TCRA) were completed at the "Fire Station 5 Berm." These activities were conducted to ensure worker safety during the construction of a Fire Station on the site. Soil, surface water and groundwater were investigated for lead, the constituent of concern. The TCRA field activities were completed in September 2010. The berm was subsequently removed under Best Management Practices to refurbish another operational berm.

Because of this Supplemental Investigation, field work was intentionally not conducted during the Phase 2 CS in this area of the MRS.

3.4.2.1 MEC and MC

No MEC field activities were conducted for this MRS in the Phase 2 CS because historical evidence suggests only small arms were used. However, observations were recorded while conducting the MC sampling. Two munitions debris items were observed during the magnetometer-assisted visual survey: a 9-mm projectile and an expended 25-mm cartridge. The 9-mm projectile was near the southernmost berm of Range N at a presumed firing point. The expended 25-mm cartridge was likely an expended cartridge disposed from a Bradley fighting vehicle located on the opposite side of the adjacent motor pool fence. It is assumed that the expended cartridge was disposed of here, but not fired here.

A total of ten soil samples were collected from the Small Arms Range - 2 and analyzed for lead. The two samples collected at the locations of EOD finds were also analyzed for aluminum, antimony, copper, zinc, and explosives. Based on the results of the metals analysis, metals were detected in concentrations exceeding USEPA Region 4 Ecological Screening Values (ESVs) for lead. No explosive compounds were detected above laboratory detection or reporting limits.

Based on the two historical EOD responses on the MRS and two munitions debris discoveries, the Small Arms Range – 2 was recommended for RFI/CMS for MEC. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.

3.4.2.2 Current and Future Anticipated Land Use

The Small Arms Range – 2 is comprised of the cantonment area, including an industrial area and warehouses, and undeveloped land. Potential future land use for the site is the cantonment area (Installation Support), including an industrial area, warehouses, tactical equipment maintenance facility, company operations facility, and undeveloped land.

3.4.2.3 Existing Engineering or Institutional Controls

There are no known site-specifics controls at this MRS.

3.4.3 Hero Road Trench Area (FTSW-008-R-01)

The Hero Road Trench Area is a 34.5-acre parcel located within the cantonment area; it was identified in January 2003, when a former Fort Stewart Directorate of Public Works (DPW) staff member reported to the DPW Environmental Office that materials (*i.e.*, mustard gas) had been buried in the DPW Family Housing Maintenance parking lot located on Hero Road. Aerial photographs indicate disturbances from January 1941 to January 1957 that are indicative of possible burial activities. Items were allegedly buried at the MRS, but not used on this MRS. Based on investigations conducted in the Phase 1 CS, Chemical Agent Identification Set (CAIS) Detonation, M1, containing 5% solution of mustard, 5% solution of lewisite, 50% solution of chloropicrin, and pure agent phosgene, is allegedly buried at the MRS. No EOD responses have been reported for this MRS. This MRS is partially fenced. This MRS is shown in Figure 3-5.

3.4.3.1 MEC and MC

During the Phase 1 CS, a limited magnetometer-assisted visual survey was conducted along the perimeter of the fence line and in the non-fenced portions located in the southern most point of the MRS. No MEC or munitions debris was observed at the Hero Road Trench Area. As a result of the limited magnetometer-assisted visual survey, the MRS acreage was found to be 34.5-acres. The MRS contains a northern fenced portion and southern unfenced portion with areas of approximately 31 and 3.5 acres, respectively.

Observations made during the visual survey indicate that the ground surface is very uneven and inconsistent in the southern most portion of the area. According to storm water management division staff at Fort Stewart, this area is not a storm water run-off area. The uneven and inconsistent ground surface is believed to be associated with the historical landfill indicating that some of the landfill remains unfenced.

One composite surface soil sample was collected from the Hero Road Trench Area and analyzed for aluminum, copper, zinc, lead, antimony, and explosives. Based on the results of the metals analysis, no residential preliminary remedial goals, now RSLs, were exceeded and lead was the only metal detected in concentrations exceeding Fort Stewart established background levels and Region 4 ESVs. No explosive compounds were detected above laboratory detection or reporting limits.

This MRS was recommended for RFI/CMS for potential MEC/MC due to alleged burials of CAIS Detonation, M1.

3.4.3.2 Current and Future Anticipated Land Use

The southern portion of the Hero Road Trench Area is undeveloped property. A portion of the area is being used as a parking lot. The northern portion of the MRS is currently fenced off, and no use has been identified. There is no known change in land use at this time; the potential future land use is assumed to remain the same as the current land use.

3.4.3.3 Existing Engineering or Institutional Controls

The northern portion of the Hero Road Trench Area is currently fenced off. Fences and signs are currently in place at the site.

3.4.4 Anti-Aircraft Range – 4 MRA (FTSW-009-R-01 and FTSW-009-R-02)

This munitions response area (MRA) is a 1,128-acre parcel located in the northern portion of the cantonment area and was used for anti-aircraft range training from 1941 to 1964. Based on the explosive hazard probability designations assigned during previous investigations performed by USACE Baltimore District Explosive Safety in 2011, the Anti-Aircraft Range – 4 MRA was divided into two MRSs. The first MRS, Anti-Aircraft Range – 4-A, includes the construction areas where the investigations / surface clearances were conducted; this area was assigned a low probability for encountering MEC. The second MRS, Anti-Aircraft Range – 4-B, encompasses the undeveloped portion of the site that was assigned a medium to high probability for encountering MEC. The majority of the area (465 acres) within the Anti-Aircraft Range – 4-A MRS is currently developed. The majority of the area (663 acres) within the Anti-Aircraft Range – 4-B MRS is currently undeveloped. A discussion of these USACE Baltimore District Explosive Safety investigations is included in Section 3.4.4.1. These MRSs are shown in Figure 3-6.

The MRA is composed of the firing points of a total of three separate/collocated ranges. The combined acreage covered by these three historical range fans is 85,325 acres, 1,128 acres of which are not in the operational range area and, thus, overlap the other than operational area and make up Anti-Aircraft Range – 4. Based on historical data, the expected munitions use associated with this MRA includes 40-mm and 90-mm anti-aircraft projectiles. The following EOD responses are examples of those that have occurred at the site: "40-mm" projectile (along the northern boundary of the site), "mortar round" (western central section of the site), "M67" hand grenade (along the southeast boundary) and "2.75-inch rocket" (southern central section of the site). Additionally, one EOD response [labeled "EOD Response (no information)"] was reported along the southern boundary and northern central section of the site. Details regarding the munitions items encountered were not available. Additional EOD responses beyond those described above have occurred at this MRS.

3.4.4.1 MEC and MC

A magnetometer-assisted visual survey was conducted during the Phase 2 CS field activities in the accessible undeveloped areas (20 acres) of the MRA, as portions of the MRA were under construction and behind a fence at the time of the investigation. No MEC or munitions debris were observed on the MRA. However, according to Fort Stewart Range Control, a number of EOD responses were reported on the MRA during the construction activities within the fenced

area from 31 August 2009 until work was halted on 1 December 2010. The majority of the EOD responses involved M2 training rockets; however, only limited information was received from Range Control.

During February 2011, the USACE, Baltimore District Explosive Safety Staff conducted a MEC Quality Assurance Investigation to Depth of Detection on areas of interest within the 4th IBCT construction site to address the EOD responses. A MEC removal action was also conducted in two construction sites (10th Engineering Battalion and Dog Kennel) which are adjacent to the 4th IBCT construction site. A total of 7 small arms (50-caliber), 16 munitions debris (15 M2 Target Rockets and one 3.5" rocket motor) and one MEC item (Point Detonating Fuze) were recovered as a result of this investigation (USACE Baltimore District, 2011a).

Following the February 2011 field effort, the USACE Savannah District and Fort Stewart Installation Officials requested that the USACE Baltimore District Explosive Safety Staff conduct a MEC Investigation to Depth of Detection on a five-acre site identified as the AAFES Mini Mart Future Construction Site located in close proximity to the 4th IBCT construction site. This investigation was conducted during April 2011. A total of 54 M2 Target Rockets, 19 M2 Target Rocket Motors and two 81-mm Practice Mortars were recovered. All items were identified as munitions debris and turned over to the local EOD unit for disposal (USACE Baltimore District, 2011b).

Four discrete surface soil samples were collected at Anti-Aircraft Range – 4 MRA and analyzed for aluminum, antimony, copper, lead, zinc, and explosives. Analytical results indicate that none of the metal concentrations exceeded USEPA RSLs or Region 4 ESVs and no explosive compounds were detected above laboratory detection or reporting limits.

The Anti-Aircraft Range – 4 MRA was recommended for RFI/CMS for MEC based on two historic EOD responses and numerous EOD responses during on-going construction activities. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.

3.4.4.2 Current and Future Anticipated Land Use

The Anti-Aircraft Range – 4 consists of the cantonment area and undeveloped former training areas. The potential future land use of Anti-Aircraft Range – 4 is planned to be the cantonment area (Installation Support, Barracks, and Operations), an Equestrian Club, and garden plots.

3.4.4.3 Existing Engineering or Institutional Controls

Fences and signs currently exist on the MRA and are associated with the ongoing construction. According to the *Final Work Plan Land Use Controls at the 4th IBCT Complex, Fort Stewart, Georgia*, dated October 2011, fencing of about 11,300 feet will be installed along the perimeter of four separate wetland areas within the Anti-Aircraft Range – 4B (FTSW-009-R-02).

3.4.5 Anti-Tank Range 90-MM – 2 (FTSW-010-R-01)

This 546-acre MRS is located in the northwestern portion of the cantonment area and was used for anti-aircraft, anti-tank, grenade launcher, and small arms training during the 1940s. The MRS is composed of eight range fans. The total acreage covered by the eight historical ranges is 17,015 acres, 546 acres of which overlap the other than operational area and make up Anti-Tank Range 90-MM – 2. The MRS is composed of the firing point of two separate collocated ranges (Anti-Tank Range 90-MM – 2 and a 40-mm anti-aircraft range) and the downrange area of six separate ranges (Ranges A, N, M, HBANM small arms range, grenade launcher range and a 120-mm anti-aircraft range). The known munitions use associated with this MRS includes 40-mm and 120-mm anti-aircraft projectiles, 40-mm grenades (practice), and 90-mm anti-tank projectiles. No documentation of EOD responses were identified at this site. This MRS is shown in Figure 3-7.

3.4.5.1 MEC and MC

A magnetometer-assisted visual survey of 10% of the undeveloped area (approximately 33 acres) was conducted during the Phase 2 CS field activities. A line approximately 120' in length of 2.5' by 2.5' concrete pads were found on this MRS. The pads may have been used for a firing line. Additionally, there was a concrete structure, approximately 10' high forming three sides of a box. Metal plates were found nearby the concrete structure. They could have been used as target structures; however, there was no indication that the plates had been fired upon. One munitions debris item, an inert anti-personnel mine, was found during the investigation.

Four surface soil samples were collected at Anti-Tank Range 90-MM - 2 and analyzed for aluminum, antimony, copper, lead, zinc and explosives. Two of the surface soil samples were collected from biased locations based on suspected firing lines. The other two surface soil samples were collected randomly throughout the site. Based on analytical results, no explosive compounds were detected above laboratory detection or reporting limits. Zinc was the only metal detected in concentrations exceeding Fort Stewart background levels and USEPA Region 4 ESVs but below USEPA RSLs. The concentrations of zinc observed at this MRS were less than an order of magnitude above the established background levels; this is likely indicative of naturally occurring conditions and not evidence of an impact of the former land use.

The site was recommended for RFI/CMS for MEC based on the discovery of an inert mine. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.

3.4.5.2 Current and Future Anticipated Land Use

The Anti-Tank Range 90-MM – 2 is comprised of undeveloped area and the cantonment area. Construction activities are currently ongoing at the MRS.

3.4.5.3 Existing Engineering or Institutional Controls

The motor pool area within the MRS is fenced.

3.4.6 Grenade Launcher Range (FTSW-011-R-01)

This 132-acre MRS is located along the western perimeter of the cantonment area and was historically used as a grenade launcher range (practice), infiltration course, 120-mm anti-aircraft range, and three small arms ranges during the 1940s. The total acreage covered by the six historical ranges is 10,947.6 acres, 132 acres of which overlap the other than operational range area and make up Grenade Launcher Range MRS. According to previous investigations, munitions used on the Grenade Launcher Range included 40-mm practice grenades, small arms, and TNT. Archival documents from 1941 document the use of .30 caliber (cal) and .50-cal machine guns on Fort Stewart. Therefore, it is assumed that .30-cal and .50-cal small arms were used on this MRS. Additionally, 120-mm anti-aircraft projectile use occurred on approximately 15 acres of the MRS. No EOD responses have been reported for this MRS. This MRS is shown in Figure 3-8.

3.4.6.1 MEC and MC

A magnetometer-assisted visual survey of 10% of the undeveloped area (approximately 4 acres) was conducted during the Phase 2 CS field activities. Piles of pop flares (expended), empty ammo cans, and expended small arms cartridges (.30-cal and .45-cal) were observed. The munitions debris appeared to be burned and discarded at the MRS, not from live-fire activities. A concrete backstop wall was also observed at the site.

Fourteen surface soil samples were collected from the Grenade Launcher Range and analyzed for aluminum, antimony, copper, lead, zinc, and explosives. Based on the results of the metals analysis, lead was the only metal detected in concentrations that exceeded USEPA Region 4 ESVs. No metals were detected at or above their respective USEPA RSLs. No explosive compounds were detected above laboratory detection or reporting limits. The concentrations of lead observed at this MRS were less than an order of magnitude above the established background levels; this is likely indicative of naturally occurring conditions and not evidence of an impact of the former land use.

The site was recommended for RFI/CMS for MEC based on range features and observed munitions debris. It is recognized that because RFI/CMS is recommended for MEC, MC may also be evaluated as part of the study.

3.4.6.2 Current and Future Anticipated Land Use

The Grenade Launcher Range is comprised of the cantonment area, including an industrial area and warehouses, and undeveloped land. In the cantonment area (Installation Support), plans include an industrial area, warehouses, tactical equipment maintenance facility, company operations facility, and undeveloped land.

3.4.6.3 Existing Engineering or Institutional Controls

There are no known site-specific controls at this MRS.

3.5 Identification and Screening of Land Use Controls

The term "LUCs" encompasses administrative and engineering methods to reduce or eliminate potential risks to human health. The Army Environmental Database-Restoration has a list of possible LUCs that includes 22 institutional controls, four engineering controls, and 21 land use restrictions (LURs). To identify appropriate LUCs for a specific installation, the list is narrowed down to include short-term interim measures options to address on-post MRSs while more permanent actions are determined.

The LUC measures considered in this Interim Measures Work Plan are listed below and described in Section 3.6.

1. Institutional Controls
    a. LURs/Notations in Base Master Plan/Dig Permit
2. Engineering Controls:
    a. Markers or Signs
    b. Fencing
3. Other Measures:
    a. Periodic Inspections (*i.e.*, Monitoring and Enforcement)

3.6 Fort Stewart/MRS-Specific LUCs

The appropriate combination of administrative and engineered LUCs is outlined here for the MRSs at Fort Stewart.

The best mix of LUCs for Fort Stewart to achieve the interim measures goals includes the following institutional controls for all seven MRSs: "LURs/Notations in Base Master Plan/Dig Permits" and "Monitoring and Enforcement". It incorporates measurable and actionable means to limit exposure to the MEC and MC at each MRS at a relatively low cost. Three of the seven MRSs (FTSW-002-R-01, FTSW-008-R-01, and FTSW-009-R-02) require additional LUC measures (*i.e.*, fencing and signage) because of the specific conditions found. Table 3-1 shows the on-post MRSs under consideration in this Interim Measures Work Plan.

Table 3-1: On-Post MRSs Recommended for Further Action

						MRS-Specific LUC Components Needed? [2]			
MRS Name	AEDB-R No.	Acres	MEC Present?	MC Present?	MRSPP Score[1]	LURs/ Notation in Master Plan / Dig Permits	Monitoring & Enforcement	Fences	Signs/ Markers
Anti-Aircraft Range 90-MM – 2	FTSW-002-R-01	77	Yes	Potential	4	Yes	Yes	IP	Yes
Small Arms Range – 2	FTSW-006-R-01	287	Yes	Potential	4	Yes	Yes		
Hero Road Trench Area	FTSW-008-R-01	34.5	Yes	Potential	6	Yes	Yes	IP	IP
Anti-Aircraft Range – 4-A	FTSW-009-R-01	465	Yes	Potential	3	Yes	Yes		
Anti-Aircraft Range – 4-B	FTSW-009-R-02	663	Yes	Potential	3	Yes	Yes	IP	Yes
Anti-Tank Range 90-MM – 2	FTSW-010-R-01	546	Yes	Potential	5	Yes	Yes		
Grenade Launcher Range	FTSW-011-R-01	132	Yes	Potential	4	Yes	Yes		

(1) The Munitions Response Site Prioritization Protocol (MRSPP) Rating is on a scale of 1 to 8, with 1 being the most hazardous. The MRSPP estimates, from the CS, are used as an indicator of the relative risks of MRSs at Fort Stewart.

(2) MRS-Specific LUC Components:

IP = In place, LUC component already exists and is in place at MRS and/or installation

Yes = LUC Component needed

Blank = LUC Component not needed

The recommended LUCs (institutional controls) to be established at Fort Stewart to enforce the restrictions above are described below.

- Restrictions on Land Use: To prevent potential receptors from encountering UXO items, it is recommended that the MRS property not be used for residential purposes, daycares, hospitals, or schools. The restrictions considered most likely to meet the on-post and interim measures constraints at Fort Stewart are:
  - Media specific restriction – Prohibit, or otherwise manage excavation
  - Restrict land use – No daycare/hospital/school use[2]
  - Restrict land use – No residential use[2]

  Conditional restrictions will also likely be required at some MRSs, such as UXO clearance to a specified depth with any excavation, drilling, or disturbance of soil, or periodic surface clearance of the MRS if certain non-intrusive activities are allowed. All restrictions will require coordination with the installation master planner and other Army stakeholders. They must be approved by the Garrison Commander.

[2] Daycare centers, hospitals, schools, and/or residential development within an MRS may only occur after appropriate review of the master plan, application of safety requirements, use of dig permits, and/or UXO construction support activities.

- **Notations In Base Master Plan:** The Installation Master Plan is used for land use and construction project planning. Notations would be updated in the Base Master Plan to identify MRSs and to document related LUC restrictions and zoning changes, if any. The Installation's Geographic Information System (GIS) can be used to demarcate the MRSs and applicable LUCs.

  LUCs are implemented through the master planning process at an installation, as described in Army Regulation 210-20, Real Property Master Planning for Army Installations (May 2005). The interim measures are incorporated into the master planning process, but by themselves do not establish the LUCs. Ultimately, the Garrison Commander will authorize the establishment of these LUCs.

  The installation master plan will be updated to include specific notations on the MRSs in the installation.

  - A notation will be added to the Base Master Plan requiring the Master Planning Division to obtain from Range Control all 911 calls involving MEC and MD (within a designated area) prior to any land use changes occurring in order to record these within a GIS database to better delineate installation-wide exposure risk.

- **Dig Permits:** Existing permit programs for the installation (such as dig permits, building permits, water/sewer connection permits, and excavation permitting systems) can be modified to include the prohibitions, restrictions, or conditions established for MEC and MC at an MRS. These are often triggered by a DA Form 4283 (Facilities Engineering Work Request) and by the follow-up Record of Environmental Consideration. The reviewing agencies will know of and convey to the applicants the LURs and LUCs at the site. In this way, the dig permits can be used to enforce prohibitions or notify construction crews of the potential risks and measures needed to mitigate risks.

  To maintain a successful permit program, a system to verify compliance with the permit program and the authority to bring violators back into compliance is required. In the particular case of a MEC-contaminated site, a permit program can be established that would require the use of appropriate UXO-qualified personnel to clear an area of MEC prior to excavation for footings or foundations.

  Because there is known ordnance, Fort Stewart has a standing policy requiring dig permits whenever ground is broken. Fort Stewart Safety reviews all dig permits and requires EOD support for areas known or have the potential to have MEC. The dig permit program will be adjusted to include review of the MRSs.

- **Monitoring and Enforcement:** The DoD Office of the Deputy Under Secretary of Defense (Environmental Security) (ODUSD(ES)) recommends the following:

  - Inspections: The inspection of LUCs should become part of existing inspections conducted at the installation. Depending on the type of LUCs, these inspections could include a visual check to ensure that proper maintenance of LUCs is taking place.
  - Environmental Self-Audit. Evaluating and verifying LUCs should be part of the Component's environmental audit and self-inspection program, and should be incorporated into the self-audit checklist and required report." (DoD, 2001a)

An annual review of the MRSs at Fort Stewart will be conducted to ensure that LUCs remain effective and land usage has not changed. The review will involve site visits and inspections conducted by a project engineer.

Additional LUCs (engineering controls) to be established are recommended for the Anti-Aircraft Range 90-MM – 2 (FTSW-002-R-01), Hero Road Trench Area (FTSW-008-R-01), and Anti-Aircraft Range – 4-B (FTSW-009-R-02) and include:

- **Fences**: A perimeter fence will be used to limit access to select portions of the three MRSs where access restrictions are necessary to prevent encounters with MEC and/or MC. While fencing exists at these three MRSs, provisions for funding the monitoring of and maintaining its effectiveness on a site-specific basis are needed.
- **Signage**: Signs and markers can be used to warn people of the potential dangers of MEC and MC at the MRS. This may limit potential contact, but will do nothing to restrict contact by those who cannot read or choose to ignore the warnings. The cost of sign installation is based on a square site covering 5 acres, with signs placed in a grid pattern every 100 yards. The costs for sign coverage are roughly proportional to the area. While signage exists at the Hero Road Trench Area (FTSW-008-R-01) MRS, provisions for funding the monitoring and maintenance of the effectiveness of the signage on a site-specific basis are needed.

URS

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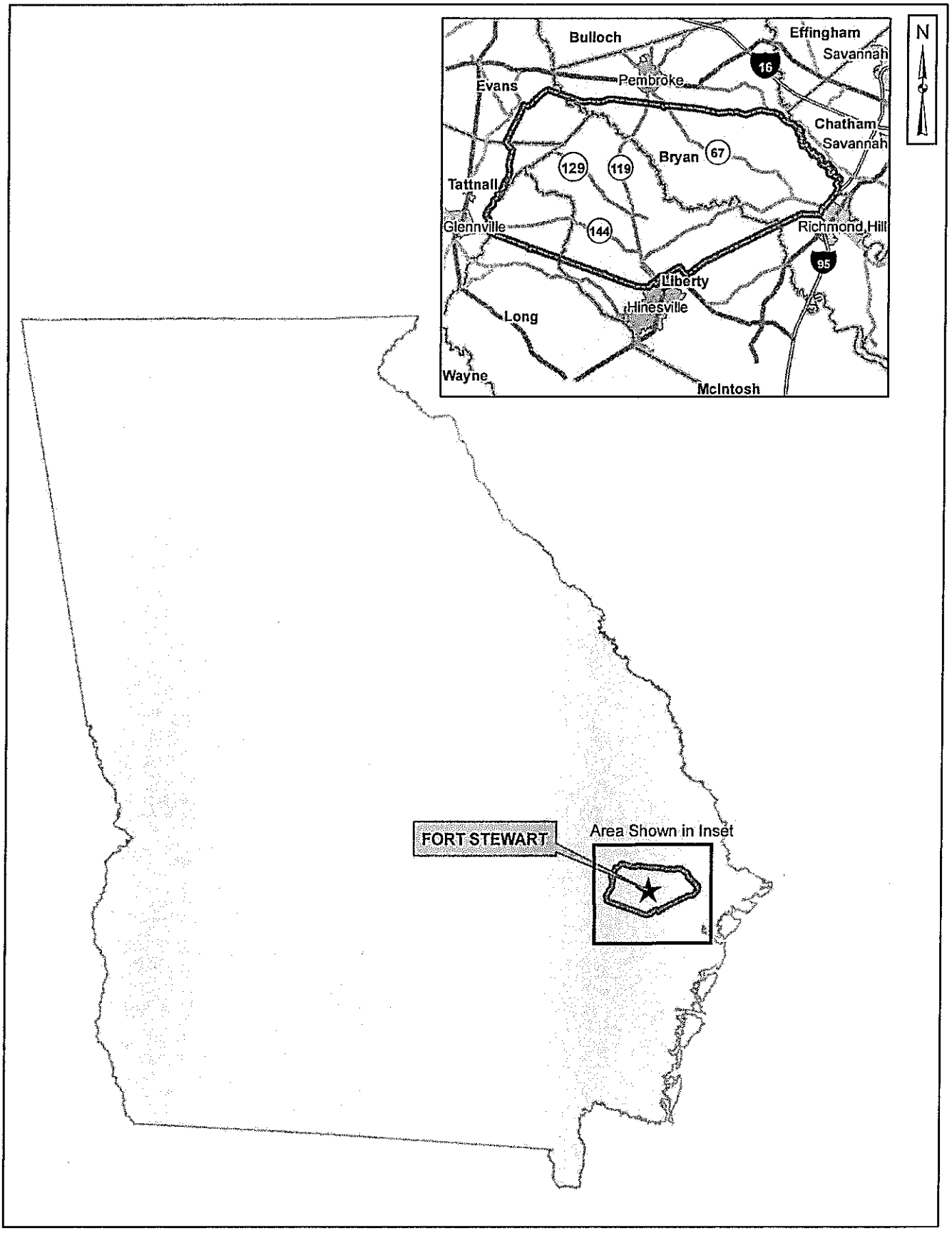
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-1
Fort Stewart Location



URS

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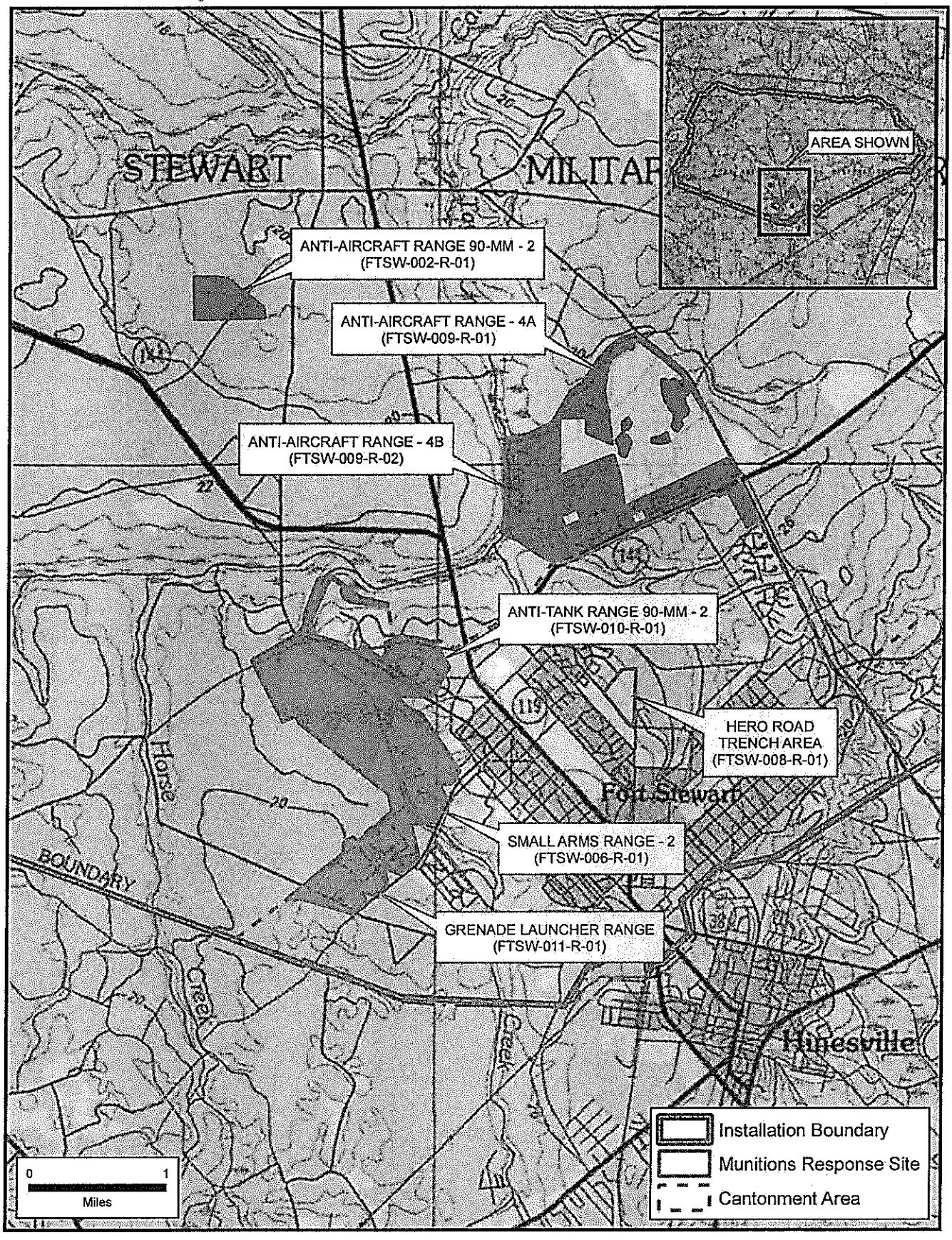
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-2
Location of MRSs at Fort Stewart



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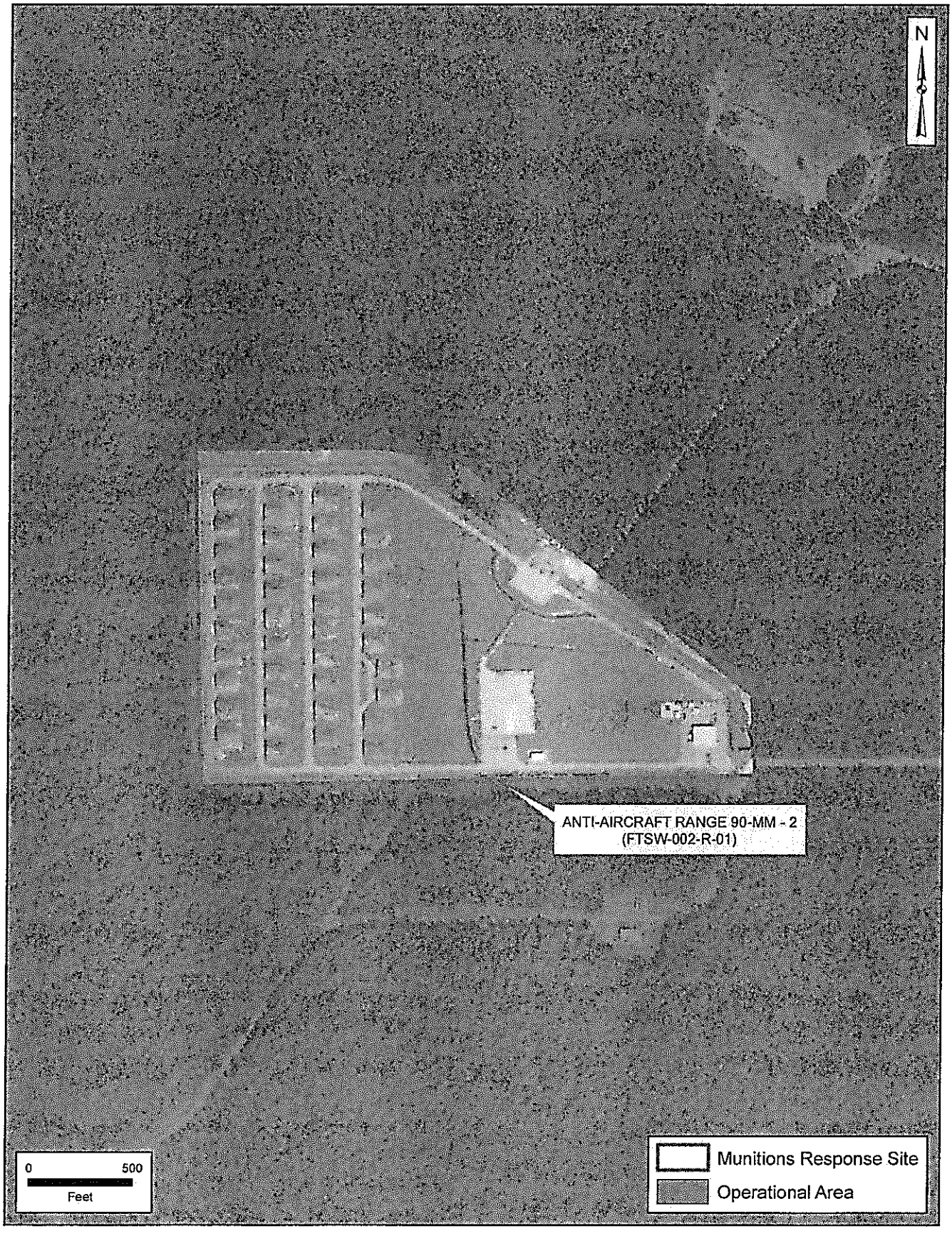
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-3
Anti-Aircraft Range 90-MM - 2



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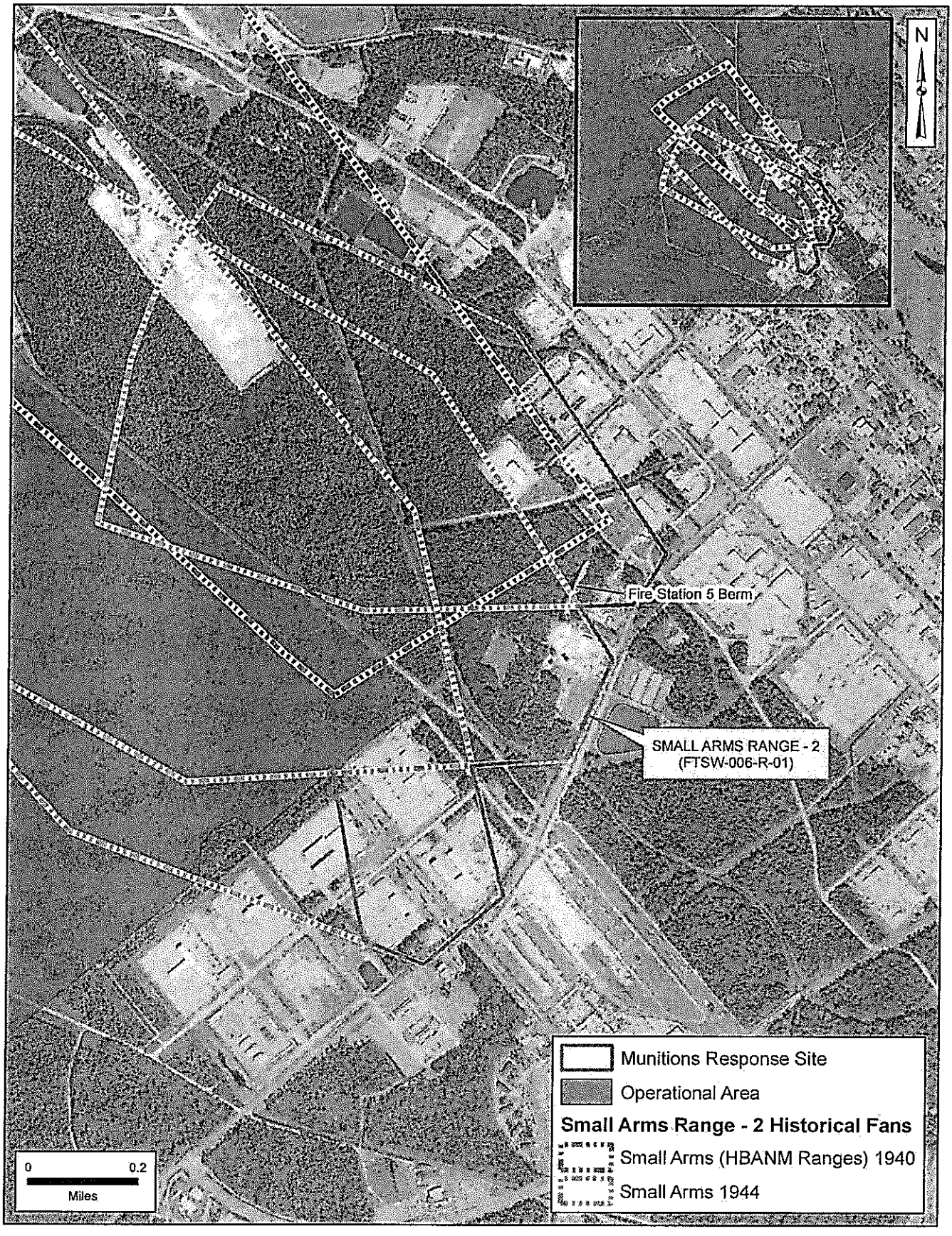
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-4
Small Arms Range - 2



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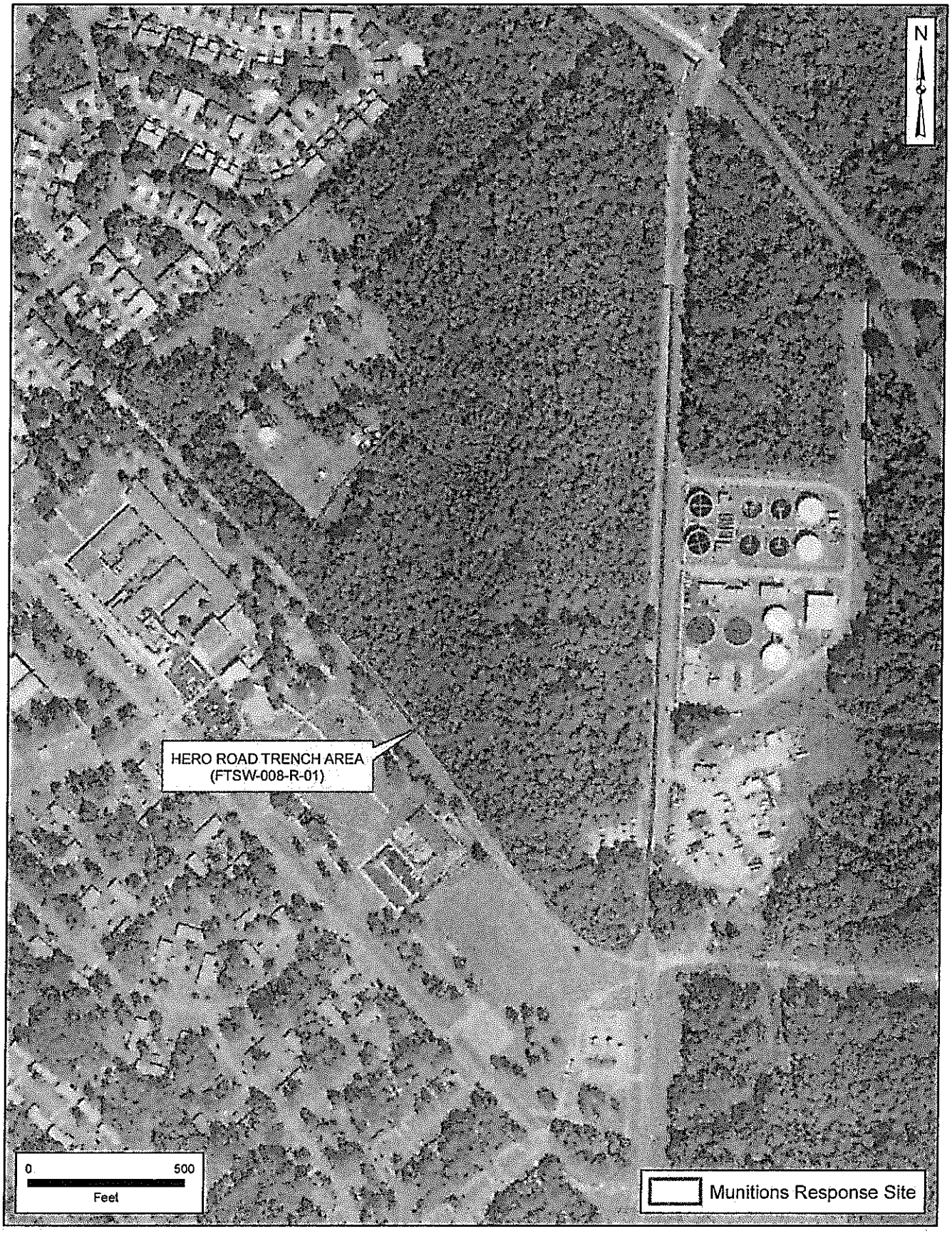
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-5
Hero Road Trench Area



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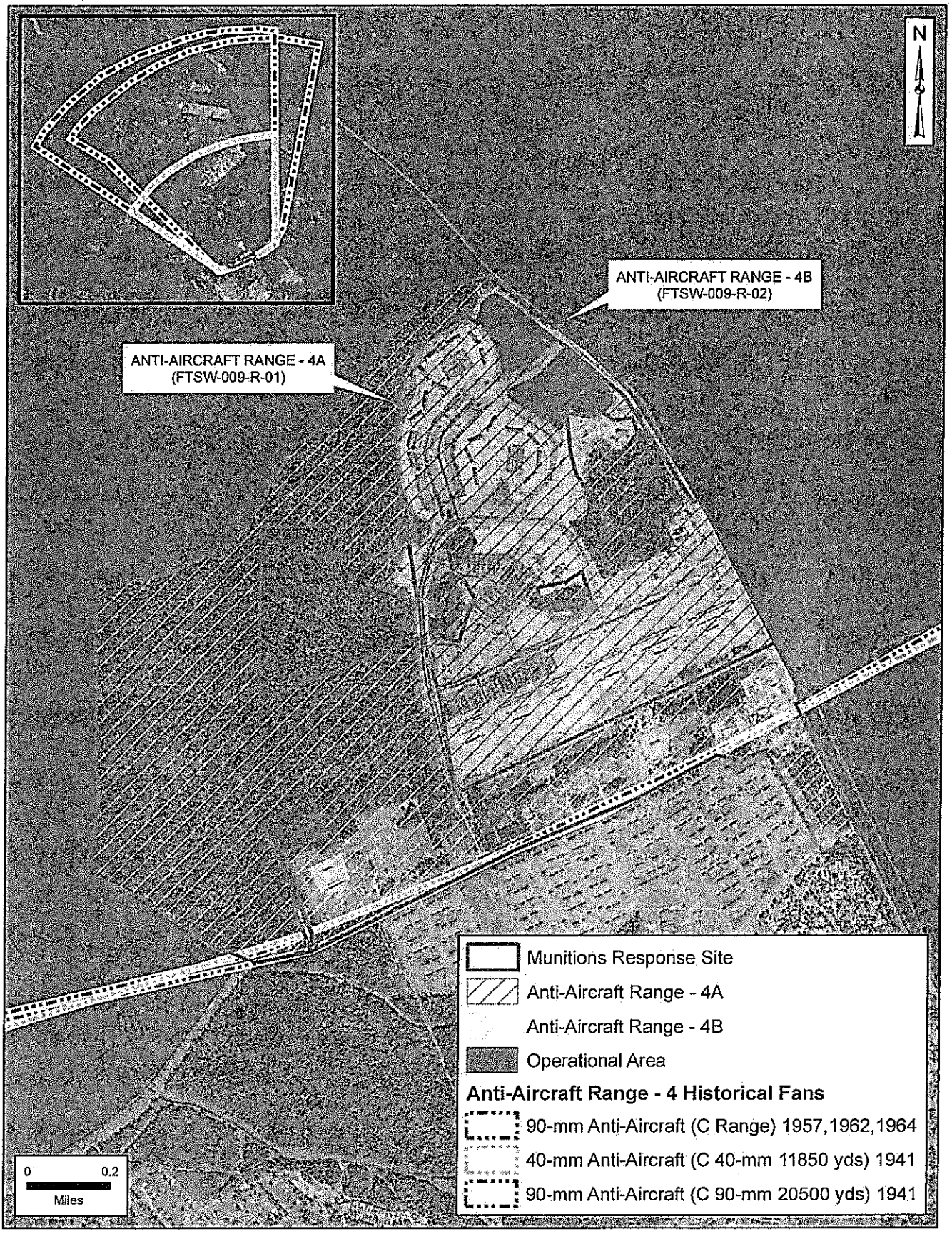
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-6
Anti-Aircraft Range - 4 MRA



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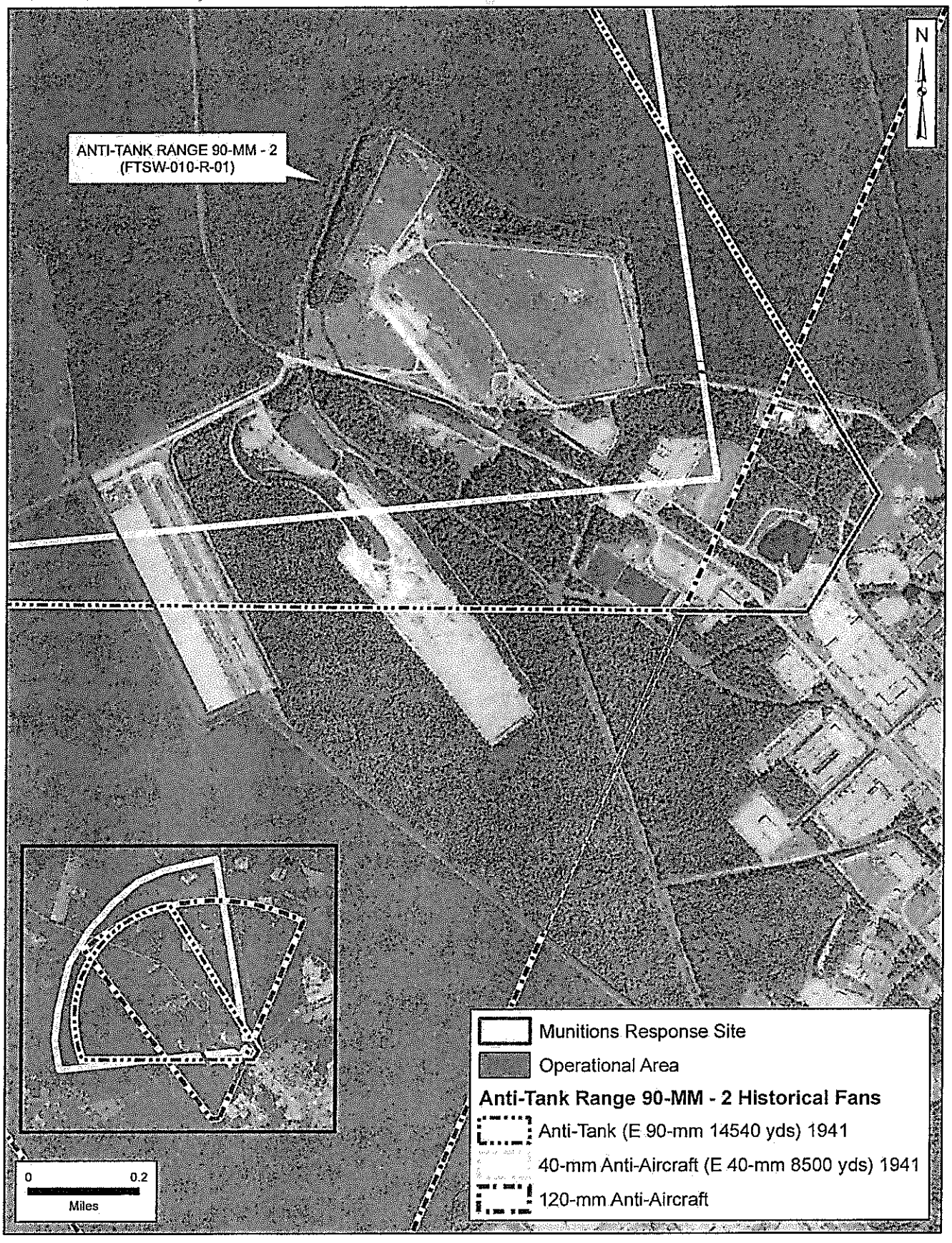
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-7
Anti-Tank Range 90-MM - 2



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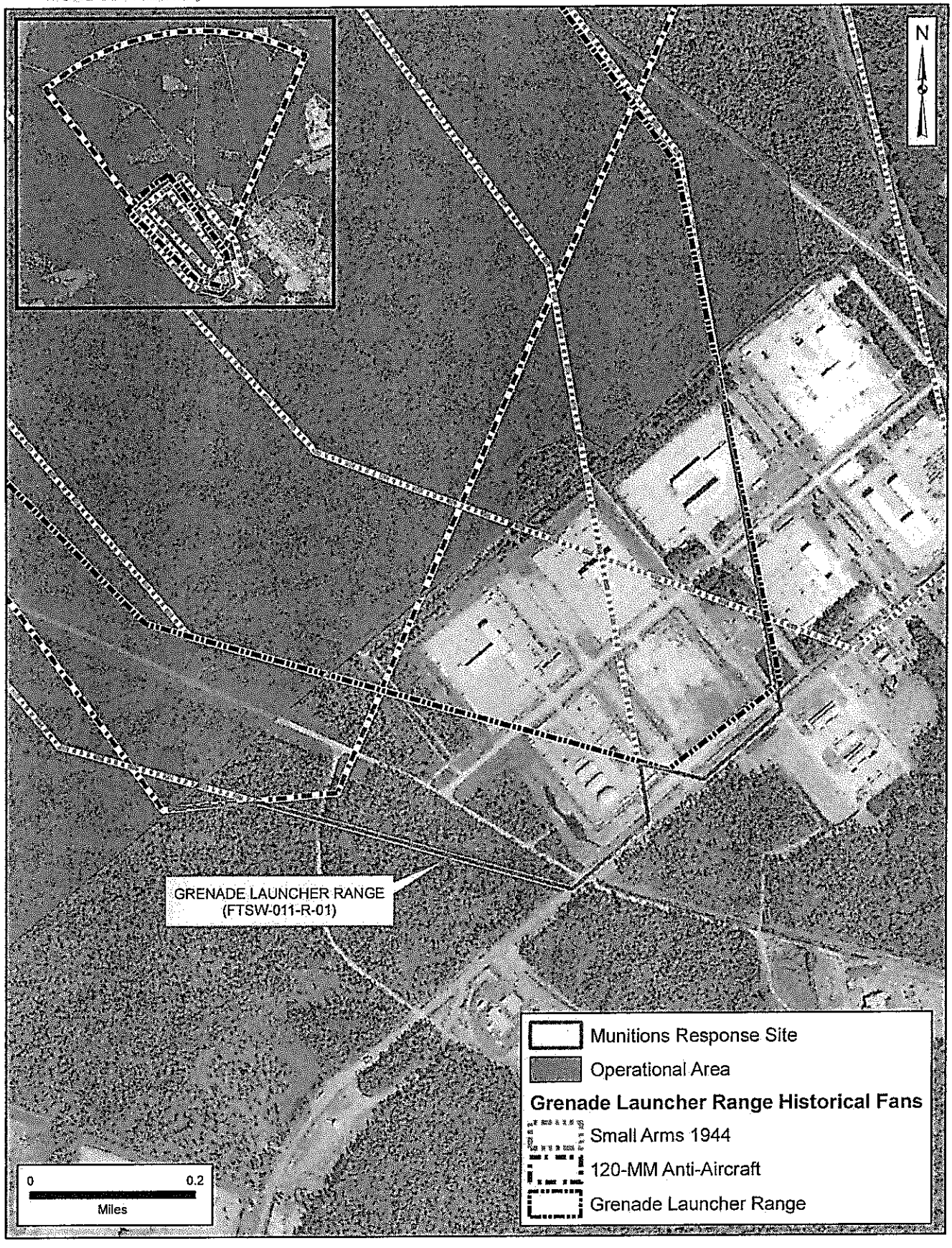
Interim Measures Work Plan
Land Use Controls
Fort Stewart, GA

Figure 3-8
Grenade Launcher Range



4 Cost

Cost estimates are reviewed as capital (first year) costs, operation and maintenance (O&M) costs, and net present value (NPV) costs.

Costs estimates were developed as shown in Appendix B. Table 4-1 summarizes LUCs components for Fort Stewart, and includes an estimate of the costs associated with each. The methodology for developing these costs is presented in Appendix B, and the methods are used to calculate MRS-specific costs proved later in this document.

Table 4-1: Components and Cost Summary of Interim LUCs at Fort Stewart
(costs are in $1,000s)

LUCs	LURs/Notation in Master Plan / Dig Permits	Signs/ Markers	Fencing	Capital Cost	Annual Operating Cost [1]	O&M Years [2]	NPV [3]
Institutional Controls [4]	X			$43.2	$15.9	4	$86.1
Engineering Controls		X	X	$11.6	$50.6	4	$632.7
Total				**$54.8**	**$66.5**	**4**	**$718.8**

Notes: Cost details are provided in Appendix B.3.

(1) Annual costs include inspections and self-audits of the LUCs.
(2) The number of years of LUC maintenance until the Corrective Measures Implementation (Construction) phase for all MRSs is completed and Long Term Management commences.
(3) A 4-year period with a 2.75% discount rate is used for economic projections.
(4) Institutional controls are not size dependent but rather funded on an installation basis.

5 Schedule

The specific schedule for the implementation of the LUCs addressed in this Work Plan will be determined at a later date and is not known at this time.

6 Health and Safety Plan

A health and safety plan will be prepared in accordance to appropriate RCRA CA guidance as part of the LUC Plan implementation, as appropriate.

7 Community Relations Plan

Given that this interim measure implementation will precede the final remedy, the installation should prepare a plan for the dissemination of information to the public regarding interim measure activities and results. These activities will include the preparation and distribution of fact sheets and participation in public meetings. This is not for the intent of soliciting public comments on a proposed interim measure, but rather to keep stakeholders and area residents informed of LUC activities.

APPENDICES

Appendix A References

Appendix B Cost Breakdowns and Assumptions

APPENDIX A: REFERENCES

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APPENDIX B

Cost Breakdowns and Assumptions

LUC Component Costs are shown for the following interim LUC components which were developed RACER (Version 10.3.0).

Appendix B.1: Institutional Controls

- Notations in Master Plan
- Dig Permits
- Monitoring and Enforcement

Appendix B.2: Engineering Controls

- Fences
- Signs

Appendix B.3: Interim LUC Components and NPV Calculations for Fort Stewart MRSs

APPENDIX B: COST BREAKDOWNS AND ASSUMPTIONS FOR LUCS

B.1: RACER Institutional Controls

Notations in Master Plan

RACER Administrative Land Use Control Technology
Implementation Tab

Assumptions/RACER Selections

Based on Modify Installation Master Plan task
Low Complexity
US location multiplier (1.0) (average costs for US as a whole)
Active Government Installation selected on Systems Definition Tab

	First Year	Annual
Cost ** =	$36,695	$0

Dig Permits

RACER Administrative Land Use Control Technology
Monitoring and Enforcement Tab

Assumptions/RACER Selections

Based on Notice Letter task
2 permits issued each year
US location multiplier (1.0) (average costs for US as a whole)
Active Government Installation selected on Systems Definition Tab

	First Year	Annual
Cost ** =	$6,530	$6,530

Monitoring and Enforcement

RACER Administrative Land Use Control Technology
Monitoring and Enforcement Tab

Assumptions/RACER Selections

Based on Site Visit/Inspections task
1 Inspection, safety level D (default), 1 day, 2 people, no airfare, no mileage
US location multiplier (1.0) (average costs for US as a whole)
Active Government Installation selected on Systems Definition Tab

	First Year	Annual
Cost ** =	$0	$9,404

Notes: * RACER Version 10.3.0
**costs include material, labor, and equipment and markup

B.2: RACER Engineering Controls

Fences and Signs

RACER technology used: Fencing

Assumptions/RACER selections

Linear feet (LF) of fencing assumes the site is square
Boundary fence type (5 foot high, galvanized chain link)
US location multiplier (1.0) (average costs for US as a whole)
Signs are placed on perimeter of sight, approximately every 220 feet
Costs shown are first year costs. Assume 10%/year annual upkeep costs.

RACER Fencing Technology

Acres	LF	Fence Cost**	# Signs	Sign Cost**	Total Cost**
1	835	$ 25,106	5	$ 466	$ 25,572
2	1,181	$ 35,469	6	$ 560	$ 36,029
3	1,446	$ 43,477	8	$ 746	$ 44,223
4	1,670	$ 50,213	9	$ 839	$ 51,052
5	1,867	$ 56,137	10	$ 934	$ 57,071
10	2,640	$ 79,379	14	$ 1,307	$ 80,686
20	3,734	$ 112,272	19	$ 1,773	$ 114,045
30	4,573	$ 137,499	23	$ 2,146	$ 139,645
40	5,280	$ 158,757	27	$ 2,519	$ 161,276
50	5,903	$ 177,488	30	$ 2,799	$ 180,287
100	8,348	$ 251,005	42	$ 3,919	$ 254,924
200	11,806	$ 354,978	60	$ 5,597	$ 360,575
300	14,460	$ 434,778	73	$ 6,811	$ 441,589
400	16,697	$ 502,038	84	$ 7,836	$ 509,874
500	18,668	$ 561,302	94	$ 8,769	$ 570,071
1000	26,400	$ 793,784	132	$ 12,315	$ 806,099
2000	37,335	$ 1,122,573	187	$ 17,446	$ 1,140,019
3000	45,726	$ 1,374,871	229	$ 21,363	$ 1,396,234
4000	52,800	$ 1,587,568	264	$ 24,628	$ 1,612,196
5000	59,032	$ 1,774,949	296	$ 27,613	$ 1,802,562
10000	83,484	$ 2,510,161	418	$ 38,994	$ 2,549,155
20000	118,064	$ 3,549,898	591	$ 55,133	$ 3,605,031

Notes: * RACER Version 10.3.0
**costs include material, labor, and equipment and markup

B.3: Interim LUC Component and NPV Calculations for Fort Stewart MRSs

Inputs and Assumptions	
Site Size (acres)	2204.5
First Year	2012
Years Interim LUCs Required	4
Annual O&M Eng. Controls	10%
i =	2.75%

Interim LUC Costs	Unit	1st Year Cost	Annual Cost	Years Required	Total	NPV
Institutional Controls - All MRSs						
LURs / Notations in Master Plan	/installation	$ 36,695	$ -	4	$ 36,695	$ 35,713
Dig Permits	/installation	$ 6,530	$ 6,530	4	$ 26,120	$ 24,419
Monitoring and Enforcement	/installation	$ -	$ 9,404	4	$ 28,212	$ 26,013
Subtotal		**$ 43,225**	**$ 15,934**		**$ 91,027**	**$ 86,145**
Engineering Controls						
Fencing for FTSW-002-R-01	~77 acres		$ 17,749	4	$ 230,734	$ 221,834
Signs for FTSW-002-R-01	~77 acres	$ 2,799	$ 280	4	$ 3,639	$ 3,498
Fencing for FTSW-008-R-01	~31 acres		$ 13,750	4	$ 178,749	$ 171,854
Signs for FTSW-008-R-01	~ 35 acres		$ 215	4	$ 2,790	$ 2,682
Fencing for FTSW-009-R-02	~200 acres		$ 35,498	4	$ 461,471	$ 443,671
Signs for FTSW-009-R-02	~663 acres	$ 8,769	$ 877	4	$ 11,400	$ 10,960
Subtotal		**$ 11,568**	**$ 50,619**		**$ 658,048**	**$ 632,665**
Total		$ 54,793	$ 66,553		$ 749,075	$ 718,810

NPV Calculations		LUC Required?	2012 TRUE	2013 TRUE	2014 TRUE	2015 TRUE	2016 FALSE	2017 FALSE	2018 FALSE	2019 FALSE
Institutional Controls	**NPV**					**Annual Cost**				
LURs / Notations in Master Plan	$ 35,713		$ 36,695	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dig Permits	$ 24,419		$ 6,530	$ 6,530	$ 6,530	$ 6,530	$ -	$ -	$ -	$ -
Monitoring and Enforcement	$ 26,013		$ -	$ 9,404	$ 9,404	$ 9,404	$ -	$ -	$ -	$ -
Engineering Controls	**NPV**					**Annual Cost**				
Fencing for FTSW-002-R-01	$ 221,834		$ 177,488	$ 17,749	$ 17,749	$ 17,749	$ -	$ -	$ -	$ -
Signs for FTSW-002-R-01	$ 3,498		$ 2,799	$ 280	$ 280	$ 280	$ -	$ -	$ -	$ -
Fencing for FTSW-008-R-01	$ 171,854		$ 137,499	$ 13,750	$ 13,750	$ 13,750	$ -	$ -	$ -	$ -
Signs for FTSW-008-R-01	$ 2,682		$ 2,146	$ 215	$ 215	$ 215	$ -	$ -	$ -	$ -
Fencing for FTSW-009-R-02	$ 443,671		$ 354,978	$ 35,498	$ 35,498	$ 35,498	$ -	$ -	$ -	$ -
Signs for FTSW-009-R-02	$ 10,960		$ 8,769	$ 877	$ 877	$ 877	$ -	$ -	$ -	$ -