Corrective Measures Study
Environmental Restoration Services at Anti-Aircraft Range– 4A (FTSW-009-R-01) United States Army Garrison - Fort Stewart

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Acronyms

Acronym	Definition
AAFES	Army & Air Force Exchange Service
AAR	Anti-Aircraft Range
AP	Armor Piercing
APP	Accident Prevention Plan
bgs	Below Ground Surface
BSEn	Bering Sea Environmental
CAP	Corrective Action Plan
CENAB	United States Army Corps of Engineers (USACE) Baltimore District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CHE	Chemical Warfare Material Hazard Evaluation
CMIP	Corrective Measures Implementation Plan
CMS	Corrective Measures Study
CS	Confirmatory Sampling
CWM	Chemical Warfare Material
cys	Cubic Yards
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DMM	Discarded Military Munitions
DoD	Department of Defense
EHE	Explosive Hazard Evaluation
EOD	Explosive Ordnance Disposal
ESS	Explosives Safety Submission
ESV	Ecological Screening Values
ft	Feet
FTSW	Fort Stewart
GAEPD	Georgia Environmental Protection Division
GIS	Geographic Information System
GPS	Global Positioning System
HA	Hazard Assessment
HE	High Explosive
HFD	Hazardous Fragment Distance
HHE	Health Hazard Evaluation
HHQ	Higher Headquarters
IBCT	Infantry Brigade Combat Team
LUC	Land Use Controls
MC	Munitions Constituents
MD	Munitions Debris
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
msl	Mean Sea Level
NCP	National Oil And Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
NOAA	National Oceanic And Atmospheric Administration
O&M	Operation and Maintenance

Acronym	Definition
OB/OD	Open Burn/Open Detonation
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RSLs	Regional Screening Levels
RTC	Response to Comment
SB	Statement of Basis
TCRA	Time Critical Removal Action
TMV	Toxicity, Mobility, or Volume (of Waste)
TNT	Trinitrotoluene
USACE	United States Army Corps of Engineers
USAEC	US Army Environmental Command
USAG	United States Army Garrison
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
UXO	Unexploded Ordnance

EXECUTIVE SUMMARY

This report presents a Corrective Measures Study (CMS) in the form of a Corrective Action Plan (CAP) for the Munitions Response Site (MRS) Fort Stewart (FTSW) FTSW-009-R-01: Anti-Aircraft Range (AAR) 4A, henceforth referred to as the Site, at Fort Stewart, Georgia. This report is prepared on behalf of the US Army Environmental Command (USAEC) in accordance with Task Order W9124J-19-F-00A4 of Contract No. W9124J-18-D-0008 and FTSW's Resource Conservation and Recovery Act (RCRA) Part B Permit No. HW-045(S)-4, as issued by the Georgia Environmental Protection Division (GAEPD) on August 15, 2017.

The purpose of this document is to outline corrective measures required to address the presence or potential presence of munitions and explosives of concern (MEC) at the Site, and to define the risk-reduction objectives for the corrective measures. This document will evaluate a range of actions/alternatives to minimize or eliminate potential risks associated with MEC and, based on this evaluation, select appropriate remedies. A conceptual design, schedule, and cost estimate will also be provided.

FTSW comprises approximately 280,000 acres, and the Garrison Area is located adjacent to Hinesville, Georgia (GA), approximately 40 miles southwest of Savannah, Georgia (Figure 1). FTSW is the largest US Army installation east of the Mississippi River. AAR-4A is in the northern portion of the cantonment area, which is the southernmost part of Fort Stewart. AAR-4A and AAR-4B were previously part of one overarching former MRS, Anti-Aircraft Range 4 (AAR 4) that has subsequently been split into two MRSs (Figure 2) owing to extensive previous MEC removal actions at AAR-4A and the classification of parts of AAR-4B as wetlands. AAR-4B is already subject to institutional and physical land use controls (LUCs), in the form of fencing and signage (around the four isolated wetlands), and was granted a no further action (NFA) status by GAEPD. The focus of this Corrective Measures Study (CMS) /CAP is AAR-4A.

The AAR encompasses the firing points and purlieu of three overlapping 40-millimeter (mm) and 90-mm anti-aircraft training ranges, operational from 1941 to 1964. These ranges fired to the north and extended beyond the defined MRSs into the greater operational area of FTSW. The 40-mm and 90-mm anti-aircraft guns were typically fired at towed aerial targets and/or M2 target rockets. The AAR 4 was split into two ranges after confirmatory sampling; the boundaries of AAR-4A and 4B MRSs are shown on Figure 2. AAR-4A contains 465 acres where MEC investigations and removals were previously conducted by the United States Army Corps of Engineers (USACE) Baltimore District (CENAB).

Throughout the course of previous studies at AAR-4A, two identifiable MEC items (one point detonating fuze, and one T91 90 mm high explosive (HE)-T projectile) were discovered in the subsurface. In addition to MEC, munitions debris (MD) was discovered throughout the site, including remnants of exploded M2 target rockets, 3.5-inch rocket motors, 40-mm projectiles, 81-mm mortars, and 2.75-inch rockets. The 2.75-inch rocket, 3.5-inch rocket, and 81-mm practice mortars were not historically documented to have been used at the Site.

All of the MEC and MD discovered during investigations at AAR-4A were discovered in the subsurface or in excavated soil at construction sites. The exact depths are unknown, but are generally considered to be in the subsurface. The pathway to subsurface exposure to MEC is considered complete. Because the MRS is heavily maintained and no MEC items have been reported on the surface, the ground surface exposure pathway is considered incomplete (CB&I, 2018).

Previous soil sampling suggests there is no observed munitions constituents (MC) hazard associated with the Site (Arcadis/Malcolm Pirnie, 2011; CB&I, 2018).

Based on previous investigations, MEC is present at the Site in the subsurface. AAR-4A includes barracks, operations facilities, brigade/battalion headquarters, tactical equipment maintenance facilities, a dining facility, a physical fitness center, a family care clinic, a dog kennel, and a shoppette. Accordingly, an unacceptable risk to human receptors is defined. Therefore, a corrective measure is required to mitigate the unacceptable risk. For this Site, the corrective measures objectives are to:

- mitigate the human exposure to potential subsurface MEC, such that an acceptable scenario is determined to be present.

Corrective measures technologies are being considered for the Site to ensure the protection of current and future receptors from hazards associated with MEC. The choices for technologies for any given site are dependent upon characteristics of the site, costs, access restrictions, as well as future land use and exposure scenarios.

To recommend alternatives that will effectively address the corrective measures objectives described above, each alternative is screened and evaluated based on the following balancing criteria:

1. Long-term Effectiveness;
2. Reduction in Toxicity, Mobility, or Volume (TMV) of Waste;
3. Short-term Effectiveness;
4. Implementability;
5. Community Acceptance;
6. State Acceptance; and
7. Cost Estimate.

Three alternatives are considered in this study: No Action, LUCs, and Subsurface Removal with LUCs. Based on the balance of the five aforementioned criteria, LUCs are selected as the recommended chosen remedy at the Site.

LUCs include actions such as land use restrictions and access restrictions to reduce the potential exposure to MEC. LUCs include engineered and non-engineered instruments such as physical barriers containing the hazards, or to prevent access to hazardous locations, as well as legal and/or administrative controls that minimize the potential for human exposure to MEC by limiting the use of land. LUCs would require monitoring of engineered and institutional controls through periodic inspections, performance of any required maintenance and repair, and reporting on a regular basis.

LUCs are effective at reducing the exposure of humans to MEC related hazards, and can be implemented in a cost-effective manner.

Implementation would require the approval of a Corrective Measures Implementation Plan (CMIP) and any other appropriate planning documents, including but not limited to an Explosives Safety Submission (ESS) and Accident Prevention Plan (APP). FTSW would be responsible for inspections and monitoring of LUCs (yearly or more frequent if specified in the Corrective Measures Implementation Plan) and preparing an Annual LUCs Status Report to the GAEPD. LUCs would meet guidelines outlined in the U.S. Department of Defense (DoD) Policy on LUCs Associated with Environmental Restoration Activities (DOD, 2001) with regard to property transfer and maintenance of LUCs to continue to protect human health and the environment.

Many of the required aspects of engineering and institutional LUCs are already in place at the Site. All digging and excavation activity at FTSW requires prior coordination with utilities providers

(georgia811.com). FTSW also has a clearance mechanism administered through its Directorate of Public Works Prevention and Compliance Branch, National Environmental Policy Act Program. All construction activities conducted on the installation are required to be processed through an Internal Job Order (IJO) review system. For activities processed through this system, the proposed construction area is assessed to determine its historical and current land use, and whether or not the site is an active or former Installation Response Site or a Military Munition Response Site. Parts of AAR-4A are already surrounded by fencing (6-foot high galvanized metal chain-link fabric and three stands of heavy gauge metal barbed wire one-foot high extending outward at the top) (URS and Arcadis/Malcolm Pirnie 2013).

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Date

1 INTRODUCTION

This report presents a CMS in the form of a Corrective Action Plan (CAP) for the Munitions Response Site (MRS) FTSW-009-R-01: Anti-Aircraft Range (AAR) 4A, henceforth referred to as the Site, at Fort Stewart (FTSW), Georgia. This report is prepared on behalf of the US Army Environmental Command (USAEC) in accordance with Task Order W912J-19-F-00A4 of Contract No. W9124J-18-D-0008 and FTSW's Resource Conservation and Recovery Act (RCRA) Part B Permit No. HW-045(S)-4, as issued by the Georgia Environmental Protection Division (GAEPD) on August 15, 2017.

The U.S. Department of Defense (DoD) established the Military Munitions Response Program (MMRP) to address DoD sites suspected to contain munitions and explosives of concern (MEC) or munitions constituents (MC). DoD policy states that these responses shall be conducted in accordance with RCRA, CERCLA, and the NCP, as applicable. This site is managed under FTSW's RCRA Part B Permit, and regulated by the GA EPD.

1.1 Purpose

The purpose of this document is to outline corrective measures required to address the presence or potential presence of MEC at the Site, and to define the risk-reduction objectives for the corrective measures. This document will evaluate a range of actions/alternatives to minimize or eliminate potential risks associated with MEC and, based on this evaluation, select appropriate remedies. A conceptual design, schedule, and cost estimate will also be provided.

1.2 Report Organization

Section 1: Introduction

Section 2: Site Characterization and Investigation Results

Section 3: Conceptual Site Model

Section 4: Corrective Measures Objectives and Corrective Action Alternatives

Section 5: Selection of Preferred Alternative

Section 6: References.

2 SITE CHARACTERIZATION AND INVESTIGATION RESULTS

2.1 Site Location

FTSW comprises approximately 280,000 acres, and the Garrison Area is located adjacent to Hinesville, Georgia (GA), approximately 40 miles southwest of Savannah, Georgia (Figure 1). FTSW is the largest US Army installation east of the Mississippi River and covers portions of Bryan, Evans, Liberty, Long, and Tattnall counties. Georgia State Highways 199 and 144 bisect the installation.

AAR 4 is in the northern portion of the cantonment area, which is the southernmost part of Fort Stewart. The MRS contains the firing points of three separate overlapping historical ranges. The MRS has been split into two ranges, AAR-4A and AAR-4B, due to differing physiographic composition, extent of development, and prior investigations. AAR-4A has been extensively investigated and developed, and AAR-4B is largely fenced, undeveloped woods and wetlands. The boundary of AAR-4B corresponds to where fencing has been installed around the MRS (Figure 2). Fencing locations were confirmed via Global Positioning System (GPS) by a KEMRON scientist in November, 2019.

2.2 Site Description and History

Prior to 1940, FTSW was the Camp Savannah Aircraft Firing Center. The installation was designated Camp Stewart in 1940 in preparation for World War II. The camp supported artillery troop anti-aircraft training, armor and tank training, GA National Guard training, and served as a separation center for redeployed troops. In 1956, Camp Stewart became Fort Stewart, a permanent Army Installation. In 1966, an element of the U.S. Army Aviation School at Fort Rucker, Alabama, was transferred to Fort Stewart, and the focus of FTSW became fixed-wing and helicopter training and gunnery training for the Vietnam War. FTSW is now home to the Third Infantry Division (Mechanized) and its current mission is to maintain quality of life, readiness, and provide support for training missions.

AAR 4 encompasses the firing points and purlieu of three overlapping 40-millimeter (mm) and 90-mm anti-aircraft training ranges, operational from 1941 to 1964. These ranges fired to the north and extended beyond the defined MRSs into the greater operational area of FTSW (Figure 3). The 40-mm and 90-mm anti-aircraft guns were typically fired at towed aerial targets and/or M2 target rockets. Munitions included steel armor piercing (AP) projectiles that could have been filled with trinitrotoluene (TNT) or Compound B (TNT/Research Department Formula X [RDX] mixtures), according to a historical review of technical data sheets. Use of other munitions at the range is not recorded in historical documents (CB&I, 2018).

AAR-4 was divided into two MRSs, AAR-4A and AAR-4B, owing to extensive cumulative MEC removal actions at AAR-4A and the classification of parts of 4B as wetlands. The boundaries of the two MRSs are shown on Figure 2. AAR-4A contains 465 acres where MEC investigations and removals were previously conducted by United States Army Corps of Engineers (USACE) Baltimore District (CENAB) and AAR-4B contains approximately 663 acres of land that are mostly undeveloped and at which removal actions have largely not occurred. Portions (four small isolated wetland areas) of AAR-4B that were subject to institutional and physical land use controls (LUCs) in the form of fencing and signage were granted a tentative no further action (NFA) status by GAEPD in a letter dated March 14, 2018. The focus of this CMS/CAP is AAR-4A.

2.3 Environmental Setting

2.3.1 Topography and Climate

The land beneath FTSW is primarily flat-lying, with surface elevations across most of the installation ranging from approximately 2 to 30 meters above mean sea level (msl). The northwestern portion of FTSW

features gently rolling hills with elevations ranging from 30 to 55 meters above msl (Arcadis/Malcolm Pirnie, 2011) (Figure 4).

The climate at FTSW is classified as humid subtropical, characterized by well-defined seasons with hot, humid summers and mild winters. The National Oceanic and Atmospheric Administration (NOAA) reports the average annual precipitation for Fort Stewart, GA, as 50 inches (NOAA, 2019).

2.3.2 Land Use and Natural Resources

FTSW includes four main types of ecosystems: sand hills, pine flatwoods, upland forests, and wetlands. Just over half of the installation comprises upland forests, which provide habitat to various plants and animals, including game hunted for recreation and human consumption. Roughly a third of the installation covered by wetlands, including black water swamps, cypress-gum swamps, stream head pocosins, bay forests, and wet pine flatwoods. Approximately 15 percent of the installation is cleared and/or developed land (CB&I, 2018). Except for the habitats provided by forested areas, there are no known site-specific, sensitive ecological or cultural resources at this MRS (Arcadis/Malcolm Pirnie, 2011).

Surface waters at FTSW include various aquatic habitats that provide fish and crustaceans for human consumption, wetlands, and water recreational areas. Surface water features include the Canoochee River, Canoochee Creek and its tributaries, both man-made and natural ponds and lakes, and numerous bottomland swamps and pools.

Land in the AAR-4A MRS is heavily developed and maintained and is accessible by people with access to Fort Stewart. The 4th Infantry Brigade Combat Team (IBCT) site occupies approximately 457 acres of the MRS and includes barracks, operations facilities, Brigade/Battalion Headquarters, tactical equipment maintenance facilities, a dining facility, a physical fitness center, a family care clinic, and a dog kennel. The MRS also features a shoppette adjacent to the highway and the South Pond Site. No changes in the land use are currently anticipated or planned.

2.4 Geology

FTSW is located within the Southern Coastal Plain physiographic province. The province comprises a wedge of gently southeast dipping clastic sediments, primarily sand, silt, and clay, overlying crystalline metamorphic basement rock. The unconsolidated sediment wedge thickens to the east, reaching a maximum thickness of approximately 2,300 meters. The metamorphic basement complex, which underlies the sediment wedge, ranges from Precambrian to Triassic in age and dips coastward at about 5.7 meters per kilometer from the Fall Line, near Macon and Augusta, GA, to the Savannah, GA area. (Arcadis/Malcolm Pirnie, 2011).

Soils at FTSW are commonly Ellabelle loamy sand, Ogeechee, Pelham, Stilson, Rutlege, Leefield, and Mascotte. Soils identified on FTSW are described as being poorly-drained. The majority of the soils observed include a sandy surface layer overlying subsurface soil that may consist of sand, clay, loam, or a combination of these. Generally, the surface soils lack cohesive clays and can be prone to erosion, however, soils at the MRS are not highly eroded, owing to relatively flat terrain and adequate vegetation (CB&I, 2018).

2.5 Hydrogeology

Coastal Plain strata underly FTSW, including three major aquifer systems. From surface to depth, these are the surficial aquifer system, the Brunswick aquifer system, and the Floridan aquifer system.

The surficial aquifer system comprises interlayered sand, clay, and thin beds of limestone. At FTSW, the surficial aquifer includes an unconfined zone ranging from 20-40 feet (ft) below ground surface (bgs) and a deeper, confined zone ranging from 50–90 ft bgs. A confining layer of silty clay and dense phosphatic limestone separates the surficial system from the deeper Brunswick aquifer system.

The Brunswick aquifer system comprises upper and lower water-bearing zones of sand and limestone separated by an approximately 70 ft thick confining layer of clay and sand. A confining unit of silty clay and dense phosphatic dolomite separate the Brunswick aquifer system from the deeper Floridan aquifer system.

The Floridan aquifer system comprises relatively permeable carbonate rocks in several water-bearing zones separated by layers of dense, relatively impermeable limestone that act as semi-confining layers. With 20 wells completed in the Floridan system (ranging from 500-800 ft, cased to 400-470 ft), the Floridan aquifer system is the primary source of potable water at FTSW (USGS, 2011; CB&I, 2018).

2.6 Historical Investigations and Remedial Actions

Historical investigations and remedial actions spanning 2010 through 2018 are summarized in the below subsections. The spatial extent and distribution of the areas covered by these investigations, when the focus was not the entire MRS, is shown on Figure 5.

2.6.1 Confirmatory Sampling (CS)

Confirmatory Sampling (CS) MEC and MC investigations were performed by Arcadis/Malcolm Pirnie in 2010 (Arcadis/Malcolm Pirnie, 2011) for CENAB. CS investigations included a magnetometer-assisted visual survey, conducted in the accessible, undeveloped areas of the AAR 4 MRS, prior to the official division of the MRS. The conclusions of this report suggest the MRS should be split into an AAR-4A and AAR-4B.

No MEC or MPPEH were observed during the visual survey, which covered approximately 20 acres. The CS Report summarized the Explosive Ordnance Disposal (EOD) team responses for items recovered during sampling, including one 40-mm projectile (MD), one mortar (unspecified type, MD), and one 2.75-inch rocket (MD).

Four soil samples were collected from randomly distributed locations associated with MD discoveries (three from AAR-4A and one from AAR-4B) to assess MC. These samples were collected from depths of 0 to 6 inches and were analyzed for aluminum, antimony, copper, lead, and zinc by USEPA Method 6010B and explosives by USEPA Method 8330B modified. None of the metals analyzed exceeded their respective regional screening levels (RSLs) nor their respective ecological screening values (ESVs). No explosives were detected at their method detection limits (MDLs) in any of the samples analyzed (Arcadis/Malcolm Pirnie, 2011).

2.6.2 MEC Quality Assurance Investigation to Depth of Detection Infantry Brigade Combat Team Construction Site

MEC and material potentially presenting an explosive hazard (MPPEH) were observed in disturbed soil during construction at the IBCT in AAR-4A in December 2010. CENAB performed a mag and flag/dig MEC Quality Assurance (QA) Investigation at the construction site in February 2011. Stockpiled soil and soil spread for topsoil across the site were investigated and any discovered MEC hazards were removed upon discovery. Sweep-lanes ensured 100% coverage of the selected areas. Over 2,000 anomalies were investigated and the following items were identified: one point-detonating fuze (MEC), 15 M2 target rockets (munitions debris [MD]), and one 3.5-inch rocket motor (MD). Seven .50 caliber cartridges were also discovered during the investigation.

CENAB recommended further investigation into other areas at the site, and that construction at the IBCT continue with "low probability" construction support protocols. CENAB also recommended that future, previously undisturbed construction sites in the area be considered "moderate to high" category for encountering MEC and appropriate MEC removal action be conducted prior to commencement of soil disturbance activities (USACE, 2011a).

2.6.3 MEC Quality Assurance Follow-On Investigation to Depth of Detection Infantry Brigade Combat Team Construction Site

CENAB performed a MEC QA Follow-On Investigation at AAR–4A at the IBCT construction site from April 11-29, 2011. The investigation followed standard mag and flag/dig protocols within exposed (i.e. not covered by construction), previously uninvestigated portions of the IBCT construction area at the MRS. Sweep-lanes ensured 100% coverage of the selected areas. Over 3,300 anomalies were investigated and no MEC items were observed. Items recovered included 54 M2 target rockets (MD), 19 M2 target rocket motors (MD), and two 81-mm practice mortars (MD).

CENAB recommended that construction at the IBCT site continue with "low probability" construction support protocols based on the guidelines established in the DoD Explosive Safety Manual 6055.9M. CENAB also recommended that future, undisturbed construction sites in the area be considered "moderate to high" category for encountering MEC and appropriate MEC removal action be conducted prior to commencement of soil disturbance activities (USACE, 2011b).

2.6.4 MEC Investigation to the Depth of Detection Army and Air Force Exchange Service Shoppette Highway 144 Construction Site

Prior to commencement of construction for the Army and Air Force Exchange Service Shoppette on Highway 144, CENAB conducted a MEC investigation to determine the MEC risk. The mag and flag/dig investigation occurred April 13-21, 2011 and covered five acres, 0.7 acres of which were determined to be inaccessible. Over 350 anomalies were investigated. No MEC was observed, but a pit (1.5 feet by 2 feet by 2 feet) containing rusted-out bodies of fuze shipping containers was observed. CENAB recommended that construction at the MRS continue with "low probability" construction support protocols based on the guidelines established in the DoD Explosive Safety Manual 6055.9M (USACE, 2011c).

2.6.5 Time Critical Removal Action

A time-critical removal action (TCRA) was conducted by Bering Sea Environmental (BSEn) for CENAB from April through June 2011, at AAR-4A surrounding the 10th Engineer Battalion Construction Site, Dog Kennel, Higher Headquarters (HHQ) site, and the South Pond.

2.6.5.1 10th Engineer Battalion Construction Site

TCRA activities at the 70-acre 10th Engineer Battalion Construction Site took place from April 19 to June 29, 2011. Activities included Schonstedt-assisted surface sweeps, grubbing, and a gridded intrusive investigation. No MEC was discovered during the removal action. An estimated 1,987 lbs of target debris and 3,498 lbs of MD, including M2 target rockets were removed from 67.95 acres (BSEn, 2011a,b,c).

2.6.5.2 Dog Kennel

TCRA activities around the Dog Kennel site took place from April 19 to June 29, 2011. Activities included a Schonstedt-assisted surface sweep, grubbing, and a gridded intrusive investigation that covered 9.9 acres. Activities during the TCRA yielded an estimated 418 lbs of target debris and 607 lbs of MD. No MEC was discovered at the site (BSEn, 2011d).

2.6.5.3 TCRA- HHQ Site

TCRA activities at the HHQ Site took place from April 20 to May 10, 2011. Removal actions included a Schonstedt sweep of the area and an intrusive investigation. 12,000 cubic yards (cys) of material were cleared with 33 M2 rockets (MD) discovered and removed. No MEC was discovered at the site (BSEn, 2011e).

2.6.5.4 TCRA- South Pond Sites

TCRA activities at the South Pond Sites took place in two stages, the first covered 12,000 cys of stockpiled material from April 21 to May 17, 2011, and the second covered 13,000 cys from May 18 to May 25, 2011. The investigation included a Schonstedt sweep of the area, land surveying, and an intrusive investigation. In total, 29 M2 (BAT) rockets (MD) and one M79 90-mm HE-T (MEC) were discovered and turned over to EOD for disposal (BSEn, 2011f,g). The M79 90-mm HE-T is referred to in subsequent reports as a T91 90-mm HE-T projectile (CB&I, 2018). This MEC item will be referred to as a T91 for the purposes of this report.

2.6.6 RCRA Facility Investigation (RFI)

An RCRA Facility Investigation (RFI) was conducted at the Site by CB&I Federal Services in 2015-2016, and the final report was finalized in March 2018 (CB&I, 2018). The RFI utilized existing data from the previous investigations, which was found to be sufficient for MRS characterization without further field efforts. Items recovered over the course of prior investigations are summarized in Table 2-1.

Prior investigations have covered 200 of the 465 acres in AAR-4A and have uncovered 2 MEC items, a point detonating fuze at the IBCT construction site and a T91 90 mm HE-T Projectile during the TCRA. Potential MEC was assumed to be dispersed since the firing points for the old range were primarily concentrated in AAR-4B.

Table 2-1 Summary of Items Recovered at AAR-4A

Source	Item Recovered	Quantity	Classification
IBCT Construction Site QA Investigation (USACE, 2011a)	Point Detonating Fuze	1	MEC
	M2 Target Rocket	15	MD
	3.5-inch Rocket Motor	1	MD
EOD Responses, Confirmatory Sampling (Arcadis/Malcolm Pirnie, 2011)	40-mm Projectile	1	MD
	Mortar (unspecified)	1	MD
	2.75-inch Rocket	1	MD
IBCT Construction Site QA Follow On Investigation (USACE, 2011b)	M2 Target Rocket	54	MD
	M2 Target Rocket Motors	19	MD
	81-mm Practice Mortar	2	MD
AAFES Shoppette Highway 144 Construction Site MEC Investigation (USACE, 2011c)	Fuze Shipping Containers	Unknown	Range Debris
TCRA: 10th Engineer Battalion Site, Dog Kennel, HHQ Site, South Pond (BSEn 2011a-g)	T91 90-mm HE-T Projectile	1	MEC
	M2 Target Rockets	62 plus	MD
	Other MD	Est. 4,105 lbs	MD
RFI (CB&I, 2018)	No Further Investigation		

All of the MEC and MD discovered during investigations at AAR-4A were discovered in the subsurface or in excavated soil at construction sites. The exact depths are unknown, but are generally considered to be in the subsurface.

Throughout the course of the previous studies, two identifiable MEC items (one point-detonating fuze, and one T91 90-mm HE-T projectile) were discovered in the subsurface. In addition to MEC, MD was discovered throughout the site, including remnants of exploded M2 target rockets, 3.5-inch rocket motors, 40-mm projectiles, 81-mm mortars, 2.75-inch rockets. The 2.75-inch rocket, 3.5-inch rocket, and 81-mm practice mortars were not historically documented to have been used at the Site. The M2 rocket fires solid projectiles which do not present an explosive hazard.

Hazards from MEC derive from direct contact with the items. Human contact that may disturb MEC in the subsurface is expected to occur in association with construction and/or maintenance activities that involve intrusive work.

Two MEC items were previously discovered in the subsurface; the pathway to subsurface exposure is considered complete. Because the MRS is heavily maintained and no MEC items have been reported on the surface, the ground surface exposure pathway is considered incomplete. (CB&I, 2018).

2.7 MEC Hazard Assessment

A MEC Hazard Assessment (HA) was completed for AAR–4A as a component of the 2018 RFI (CB&I, 2018). The HA was based on 2008 USEPA Interim MEC HA Methodology, which evaluates the potential explosive hazard associated with conventional MEC present at an MRS under a variety of site conditions. This method considers various clean up scenarios and land-use assumptions, but does not address explosive or toxic hazards associated with chemical warfare materiel (CWM), underwater MEC, nor non-explosive hazards (e.g. environmental) that may be associated with MEC. The following is a summary of the assessment completed in the 2018 RFI (CB&I, 2018).

The MEC HA was structured into three components: severity, accessibility, and sensitivity. These categories each incorporate two or more input factors that are each given a numeric score. These scores are added to calculate a hazard level. Hazard levels are ranked 1 to 4 with higher numbers corresponding to lower potential explosive hazards.

Table 2-2 MEC Hazard Assessment Scores

Hazard Level	Minimum MEC HA Score	Maximum MEC HA Score	Description
1	840	1000	Highest potential explosive hazard condition
2	725	835	High potential explosive hazard condition
3	530	720	Moderate potential explosive hazard condition
4	125	525	Low potential explosive hazard condition

2.7.1 Severity

The MEC HA guidance defines severity as, "[t]he potential consequences of the effect (e.g. injury or death) on a human receptor should a MEC item detonate." Both primary and secondary receptors are taken into consideration in this assessment. Severity is based on the energetic material type and location of human receptors.

The discovery of the T-91 90 mm HE-T projectile at AAR-4A determined that the material type is considered high explosive (HE). According to the DoD fragmentation database, the hazardous fragment distance (HFD) for this projectile is 288 feet. Areas within the MRS and within 288 feet of the boundary of the MRS where humans are likely to congregate are considered in the analysis. These include the dog kennel and the IBCT complex, composed of barracks, a dining facility, a fitness center, operations facilities, brigade/battalion headquarters, a tactical equipment maintenance facility, and a family care clinic. As

construction on many of these was recently completed, the location of human receptors is considered unlikely to change in the near future (CB&I, 2018).

2.7.2 Accessibility

MEC HA guidance defines accessibility as, "[t]he likelihood that a human receptor will be able to come into contact with a MEC item." Accessibility considers site accessibility, potential contact hours, amount of MEC, minimum MEC depth relative to the maximum receptor intrusive depth, and migration potential. AAR-4A is accessible by people with access to Fort Stewart, so it is considered to have "Full Accessibility." Potential contact hours are the estimated potential contact hours per year, and are based on normal operating activities for maintenance and construction workers. These were estimated to be 6,600 hours per year, which is categorized as "very few hours" according to MEC HA guidance.

The amount of MEC is a qualitative category for estimating quantities of MEC expected to be in an area (e.g. open burn/open detonation [OB/OD] area, firing points, safety buffer area, storage, etc.). Based on historical records, AAR-4A is considered a firing point.

The minimum MEC depth relative to the maximum receptor intrusive depth input characterizes the likelihood of a receptors interacting with potential MEC. MEC discovered in AAR-4A were all in previously excavated soils, so the depth of discovery was conservatively estimated as directly below ground surface, which would put MEC within the range of construction, maintenance, and landscaping activities. Migration potential describes the likelihood that MEC items can be moved and exposed by natural process including erosion and frost heaving. Climate and topography determined this input factor to be "Not Probable" (CB&I, 2018).

2.7.3 Sensitivity

MEC HA guidance defines sensitivity as, "the likelihood that a MEC item will detonate if a human receptor interacts with it." Sensitivity is determined using MEC classification and MEC size. MEC classification is given as six categories: UXO Special Case, UXO, Fuzed Discarded Military Munitions (DMM) Special Case, Fuzed DMM, Unfuzed DMM, and Bulk Explosives. The 90 mm HE-T projectile at AAR-4A was found with no fuze and with no clear indication of whether it had been fired, and is classified as "Unfuzed DMM".

MEC size is used to account for the ease with which a receptor could move the MEC. Smaller, more portable items are more likely to be picked up and disturbed by a potential receptor. MEC is classified as "small" (less than 90 pounds [lbs]) or "large" (90 lbs or heavier), and if any of the MEC reported is less than 90 lbs, then "small" must be used as the input. Both MEC items at AAR-4A were less than 90 lbs (CB&I, 2018).

2.7.4 MEC HA Results

The input factors, as discussed in Sections 2.7.1 through 2.7.3, were used in the MEC HA automated workbook. Based on current conditions at the Site and the current use scenario, the MEC HA methodology yielded a score of 545, and a Hazard Level of 3 (moderate potential explosive hazard condition) (CB&I, 2018).

3 CONCEPTUAL SITE MODEL

3.1 Source

Section 2.6.6 describes the source of MEC investigated during the 2018 RFI. In this model, the source contamination consists of MEC discovered in the subsurface.

3.2 Interaction

All of the MEC and MD discovered during investigations at AAR-4A were discovered in the subsurface or in excavated soil at construction sites. The exact depths are unknown, but are generally considered to be in the subsurface. The MRS is heavily used and maintained, and no MEC items have been reported on the surface. Potential receptors walking in the area are not expected to interact with MEC. MEC is not anticipated at the surface.

Hazards from MEC derive from direct contact with the MEC. Human contact that may disturb MEC in the subsurface is expected to occur in association with construction and/or maintenance activities that involve intrusive work (CB&I, 2018).

3.3 Receptors

AAR-4A comprises barracks, administrative buildings, a dog kennel, and a shoppette/exchange. Receptors identified in the 2018 RFI include:

- Residents living in the barracks
- Indoor Facility Workers who occupy FTSW buildings or the shoppette for work purposes
- Maintenance and Construction Workers who may perform landscaping, grounds keeping, or excavation activities
- Visitors who may access the area or visit the shoppette.

All of these potential receptors are expected to walk around or through the MRS, primarily on sidewalks, roads, and green spaces. No interaction with MEC is expected during these activities, as MEC is not anticipated on the ground surface. Maintenance and construction workers potentially performing activities involving earth moving or excavation could encounter subsurface MEC (CB&I, 2018).

4 CORRECTIVE MEASURES OBJECTIVES AND CORRECTIVE ACTION ALTERNATIVES

4.1 Establishment of Corrective Measures Objectives

Based on previous investigations, MEC is present at the Site in the subsurface. AAR-4A includes barracks, operations facilities, brigade/battalion headquarters, tactical equipment maintenance facilities, a dining facility, a physical fitness center, a family care clinic, a dog kennel, and a shoppette. Accordingly, an unacceptable risk to human receptors is defined. Therefore, a corrective measure is required to mitigate the unacceptable risk. For this Site, the corrective measures objectives are to:

- mitigate the human exposure to potential subsurface MEC, such that an acceptable scenario is determined to be present.

Based on results of the RFI, the analysis of existing data used to evaluate the extent of MEC and exposure pathways to MEC in the subsurface, a CMS is required to address MEC in the subsurface pursuant to the corrective measures objectives.

4.2 Establishment of Corrective Action Alternatives

Corrective measures technologies are being considered for the Site to ensure the protection of current and future receptors from hazards associated with MEC. The choices for technologies for any given site are dependent upon characteristics of the site, costs, access restrictions, as well as future land use and exposure scenarios.

To recommend alternatives that will effectively address the corrective measures objectives described above, each alternative will be screened and evaluated based on the following balancing criteria:

1. Long-term effectiveness
2. Reduces TMV of Waste
3. Short-term effectiveness
4. Implementability
5. Community Acceptance
6. State Acceptance
7. Cost Estimate.

Such a recommendation shall include a description and supporting rationale for the proposed remedy, including how it will achieve the clean-up objectives and the proposed remedy's relationship to the balancing criteria.

In accordance with the RCRA permit for Fort Stewart and utilizing USEPA Guidance on RCRA Corrective Action Decisions Documents (EPA/540/G-91/011; USEPA, 1991), all alternatives will require the preparation of a Statement of Basis (SB) document. The SB will undergo a Public Comment Period followed by the preparation of a response to comment (RTC) document. Additional aspects of the individual corrective measures alternatives are detailed in the following sections.

Three alternatives were selected for evaluation for AAR-4A:

1. No Action
2. Land Use Controls

3. MEC Subsurface Clearance

In the following subsections, these three alternatives are evaluated using the balancing criteria. A summary of the balancing criteria evaluation is presented in Table 4-1.

Table 4-1 Summary of Balancing Criteria

Alternatives	Long-Term Effectiveness	Reduces TMV	Short-Term Effectiveness	Implementability	Cost Estimate
No Action	Ineffective	Ineffective	Ineffective	High Ease	$18,144
Land Use Controls	Effective	Effective	Effective	Moderate Ease	$267,049
Subsurface Removal and LUCs	Effective	Effective	Effective	Low Ease	$1,070,454

4.2.1 Alternative 1 – No Action

Alternative 1 takes a "No Action" approach as a Corrective Action Alternative. No Action does not require the use of technologies associated with a response action. This option does not include any institutional controls or any action to control, treat, remove or dispose of MEC associated with the Site. This alternative is included to provide a status quo baseline for comparison to the other alternatives. The balancing criteria for Alternative 1 are described below.

Long-term Effectiveness
Alternative 1 does not effectively address site risk for the long-term. Since the Site has been determined to have moderate explosive risk, Alternative 1 would not address the hazardous risk under analogous site conditions over an extended period of time.

Reduces TMV of Waste
Alternative 1's "No Action" approach does not reduce the volume of MEC or alter the pathway through which humans may be exposed to MEC.

Short-term Effectiveness
Alternative 1 does not effectively address site risk for the short-term. Since the Site has been determined to have moderate explosive risk and the Site currently has a population with a moderate risk of encountering MEC, Alternative 1 would not address the hazardous risk to receptors.

Implementability
Alternative 1 is highly implementable and requires no effort beyond the SB. No additional administrative activities are required, no time is required to implement, and no technologies are required to implement the alternative.

Community Acceptance
Community Acceptance of Alternative 1 is unlikely. It is improbable that the community will accept "No Action" towards mitigating potential explosive hazards.

State Acceptance
State Acceptance of Alternative 1 by is unlikely. The "No Action" approach is not sufficient in mitigating potential explosive hazards.

Cost Estimate
Alternative 1 is considered a low-cost alternative for the Site, incorporating only the cost for the SB. The estimated cost to implement this alternative is $18,144.

Alternative 1 is not an effective approach at reducing the exposure of humans to MEC related hazards through the means of inaction. Alternative 1 is not retained for the Site.

4.2.2 Alternative 2 – Land Use Controls

LUCs include actions such as land use restrictions, and access restrictions to reduce the potential exposure to MEC. LUCs include engineered and non-engineered instruments such as physical barriers containing the hazards, or to prevent access to contaminated locations, as well as legal and/or administrative controls that minimize the potential for human exposure to MEC by limiting the use of land. LUCs would require monitoring of engineered and institutional controls through periodic inspections and reporting on a regular basis.

LUCs already in place at AAR-4A include a perimeter fence and base-wide institutional controls restricting any intrusive activities at FTSW. The perimeter fence surrounding AAR-4A was installed during implementation of LUCs at AAR-4B, which surrounds AAR-4A (URS and Arcadis/Malcolm Pirnie, 2013). While the fencing restricts unintentional access to AAR-4A through unofficial routes, points of ingress to the MRS are uncontrolled and may require the installation of gates if further restriction of access to AAR-4A is desired. This may not be necessary, as only the subsurface pathway is complete at the MRS and unintentional contact with MEC is not expected from normal surficial activities, such as walking around the MRS. Signage with warnings pertaining to the MEC hazard and an installation contact for potential MEC encounters posted on the existing fence and at points of ingress to AAR-4A would be considered a minimum requirement of LUC implementation (Figure 6). Specific sign verbiage would require approval from the GAEPD and the installation. Signs would be fence-mounted where possible, and post-mounted otherwise. The Base-wide LUC plan would require an update to further emphasize restrictions of digging in areas of AAR-4A that have not already been disturbed or cleared in previous investigations. Prior to initiation of subsurface work, including excavation and construction, a review will be performed to determine the presence of risk due to MEC. Construction at AAR-4A should be performed with “low probability” construction support protocols. Construction in areas that have not been previously investigated or disturbed should be considered at “moderate to high” risk of encountering MEC and appropriate removal action should be conducted prior to commencement of soil disturbance activities.

Long-term Effectiveness
Alternative 2 is effective on a long-term basis by limiting potential exposure to MEC through engineered and institutional controls, preventing impermissible access, construction, or intrusive work to be allowed in affected areas without prior investigation into presence of MEC in the affected area.

Reduces TMV of Waste
Alternative 2 is an effective approach to reducing the hazardous risk to receptors. Institutional controls are maximized when implemented alongside engineering controls like fencing and signage. While Alternative 2 does not reduce the volume of MEC, Alternative 2 is effective at reducing hazardous risk by mitigating the exposure pathways to humans.

Short-term Effectiveness
Alternative 2 is immediately effective in the short-term by preventing unintentional access to subsurface through signage and by providing administrative controls on the development of the land.

Implementability
Alternative 2 is implementable with moderate ease. Administrative activities would be required to implement the corrective measure, in the form of updates to the Base-wide Master LUC plan, and a Corrective Measures Implementation Plan (CMIP) in the form of a LUC plan. Alternative 2 is moderately easily constructed, as fencing already surrounds AAR-4A, and physical LUCs would only require procurement, installation, surveying, inspection, and upkeep of signage around the MRS. Construction of Alternative 2 requires the installation of up to 154 numbered signs no greater than 200 feet apart (Figure 6). Signage is not difficult or prohibitively expensive to acquire or install, and no scarce materials or technology is required for implementation of this alternative.

Community Acceptance
Community Acceptance of Alternative 2 is probable. Alternative 2 does not significantly alter the manner in which the public will interact with the Site.

State Acceptance
State Acceptance of Alternative 2 is probable. Given that the pathway to MEC is only complete for the subsurface, and the MRS is already heavily developed, unintentional interaction with MEC is relatively unlikely. Alternative 2 provides sufficient control to decrease this likelihood even further for any potential future intrusive activities.

Cost Estimate
Alternative 2 is considered as the "moderate cost" alternative for this Site. The estimated cost to implement this alternative is $267,049. Support for this estimate is provided in Appendix A. For the purpose of cost-to-completion estimates, Army protocol dictates a period of 30 years be used to account for long term O&M of LUCs if no definitive closure date is known. While 30 years will be used for cost estimates, LUCs, if implemented, will be maintained until base closure or MEC at the site is otherwise remedied.

Alternative 2 is effective at reducing the exposure of humans to MEC related hazards, and can be implemented in a cost-effective manner. Therefore, Alternative 2 is retained for the Site and will be discussed further in Section 5.

4.2.3 Alternative 3 – MEC Subsurface Clearance

Alternative 3 consists of a MEC subsurface clearance conducted by qualified UXO personnel in addition to the implementation of interim LUCs until completion of the removal action. MEC removal would be conducted by qualified UXO and geophysical personnel to identify and remove MEC in the subsurface using mag and dig or digital geophysical mapping (DGM), as appropriate. Anomalies identified as potential MEC would be excavated, investigated, and removed and disposed of. Areas of AAR-4A that have already been investigated or cleared are shown in Figure 7. The clearance associated with Alternative 3 would focus on areas that have not already been investigated, or disturbed for building construction. The areas of AAR-4A that have not previously been cleared and would require removal action accordingly are displayed in Figure 7. The required additional investigation area consists of approximately 34.2 non-contiguous acres.

LUC implementation would be required until such time as the subsurface removal is complete and the Site is granted a NFA status. Interim LUCs would include institutional controls and signage as discussed in Section 4.2.2; however, these LUCs would only need to be inspected and maintained until such time that the removal action is complete and the Site is granted an NFA status.

Long-term Effectiveness
Alternative 3 is effective in the long-term by providing empirical data on the location, disposition, and disposal of anomalies and potential MEC items. These items would then be disposed of and removed from

consideration in a MEC HA. An NFA status could be assigned to the site, and no additional future consideration would be necessary.

Reduces TMV of Waste

Alternative 3 would provide the greatest level of reduction of TMV by physically reducing the volume of MEC at the Site.

Short-term Effectiveness

Alternative 3 is moderately effective in the short-term. LUCs would have to be implemented in conjunction with the removal activities to keep site workers and installation workers safe during the removal activities.

Implementability

Alternative 3 is the most difficult alternative to implement. The implementability of the LUCs is discussed in Section 4.2.2, although the engineering or physical LUCs would be inspected and maintained over a shorter duration. The removal action involved in Alternative 3 would require administrative efforts including preparation of necessary planning documents (e.g. a CMIP, Explosives Safety Submission (ESS), and APP). The removal action would require a team of UXO professionals. The challenge of maintaining a 288 ft exclusion zone around the removal action, which is based on the HFD of the previously identified MEC at the site, in the heavily developed IBCT, which includes residential areas, offices, and healthcare facilities, would be considerable. Additional consideration will need to be taken for safe and proper disposal of any MEC items recovered during removal action. This consideration would add time, cost, and inconvenience to base residents and workers. Technologies required would include analog magnetometers and could include DGM.

Community Acceptance

Community Acceptance is somewhat unlikely. Alternative 3 is the highest cost and highest inconvenience to the public. Maintenance of a 288 ft exclusion zone around clearance activities would require building evacuations and interruption of operations at the ICBT complex. As the explosive risk is only in the subsurface and this area includes barracks and medical facilities, Alternative 3 runs the risk of being perceived as an expensive, unnecessary inconvenience.

State Acceptance

State Acceptance of Alternative 3 is likely. Alternative 3 is the most effective alternative at reducing the explosive hazard at the MRS by physically reducing the volume of MEC.

Cost Estimate

Alternative 3 is considered as the “high cost” alternative for this Site. The estimated cost to implement this alternative is $1,070,454. Support for this estimate is provided in Appendix A.

Alternative 3 is effective at reducing the exposure of humans to MEC related hazards, but is not considered sufficiently easily implementable, considering the potential complications of removal actions in more heavily populated and developed areas, or cost-effective relative to Alternative 2. Therefore, Alternative 3 is not retained for the Site.

5 SELECTION OF PREFERRED ALTERNATIVE

5.1 Preferred Alternative

Based on assessment of the alternatives described in the previous section, the preferred Corrective Action Alternative for this Site is Alternative 2 – LUCs. This alternative is preferred because the Site has been extensively developed for long-term industrial and residential land use with the installation of barracks, operations facilities, Brigade/Battalion Headquarters, tactical equipment maintenance facilities, a dining facility, a physical fitness center, a family care clinic, and a dog kennel. Implementing institutional controls to prevent any potential future unauthorized intrusive work and to review potential need for further investigation prior to authorized intrusive work in areas with the potential to encounter MEC is effective in reducing the likelihood for humans to encounter MEC in a cost-effective manner.

Alternative 2 would include LUCs in the form of institutional and engineering controls. Institutional controls would include restrictions on any intrusive activity, including but not limited to construction, trenching, and earth-moving operations, pending subsurface investigation in any area where these activities are proposed. Engineering controls would include warning/informational signs identifying potential explosive conditions posted around areas where exposure pathways are complete for humans. Limiting access would prevent exposure of human receptors to MEC in the subsurface. An estimated total of 154 signs would be spaced every 200 feet as shown on Figure 6.

These land use and access controls would be incorporated, where applicable, into the FTSW Master Plan, and other applicable systems, such as geographic information systems (GIS). The installation Master Plan would be amended to ensure the regular inspection and maintenance of fencing and signage.

Implementation would require the approval of applicable planning documents and addendums to the FTSW Master Plan. FTSW would be responsible for inspections and monitoring of LUCs (yearly or more frequent if specified in the CMIP) and preparing an Annual LUCs Status Report to be submitted for approval by GAEPD in accordance with the RCRA Permit. LUCs would meet guidelines outlined in the DoD Policy on LUCs Associated with Environmental Restoration Activities (DOD, 2001) with regard to property transfer and maintenance of LUCs to continue to protect human health and the environment. Regular inspections of LUCs would include completing a LUC inspection form with, at a minimum, the date and time of the inspection, the name of the inspector, a notation of the observations made, which fence/signs (if any) require maintenance or replacement, and the date and nature of any repairs or other remedial actions taken. The duration of operation and maintenance (O&M) for these LUCs for cost-to-complete calculation purposes is 30 years, but actual O&M for these LUCs will continue until base closure, or until subsurface MEC is otherwise remedied and an NFA status is determined.

Many of the required aspects of engineering and institutional LUCs are already in place at the Site. All digging and excavation activity at FTSW requires prior coordination with utilities providers (georgia811.com). FTSW also has a clearance mechanism administered through its Directorate of Public Works Prevention and Compliance Branch, National Environmental Policy Act Program. All construction activities conducted on the installation are required to be processed through an Internal Job Order (IJO) review system. For activities processed through this system, the proposed construction area is assessed to determine its historical and current land use, and whether or not the site is an active or former Installation Response Site or a Military Munition Response Site. Additionally, AAR-4A is already surrounded by fencing installed as a remedial measure for AAR-4B (6-foot high galvanized metal chain-link fabric and three stands of heavy gauge metal barbed wire one-foot high extending outward at the top) (URS and Arcadis/Malcolm Pirnie, 2013). Additional signage will be required at points of ingress/egress from AAR-4A.

5.2 Precedence in Support of the Preferred Alternative

The preferred alternative at AAR-4A is the implementation of LUCs to minimize potential contact between receptors and any MEC remaining in the subsurface. Similar LUCs were utilized at the adjacent MRS, AAR-4B. After completion of the implementation of LUCs including fencing and institutional controls at AAR-4B, the site was granted an NFA status by the GAEPD.

5.3 Schedule

It is estimated that the preparation and approval of CMIP/LUCIP documents will take nine months. Procurement and mobilization to install signage is estimated to take one month and installation of the signs is estimated to take two months. Demobilization is estimated to take half a month. Reporting after the field effort is expected to take six months. O&M is expected to continue until base closure or until such time as the site is otherwise remedied. These are estimates and the actual schedule may vary.

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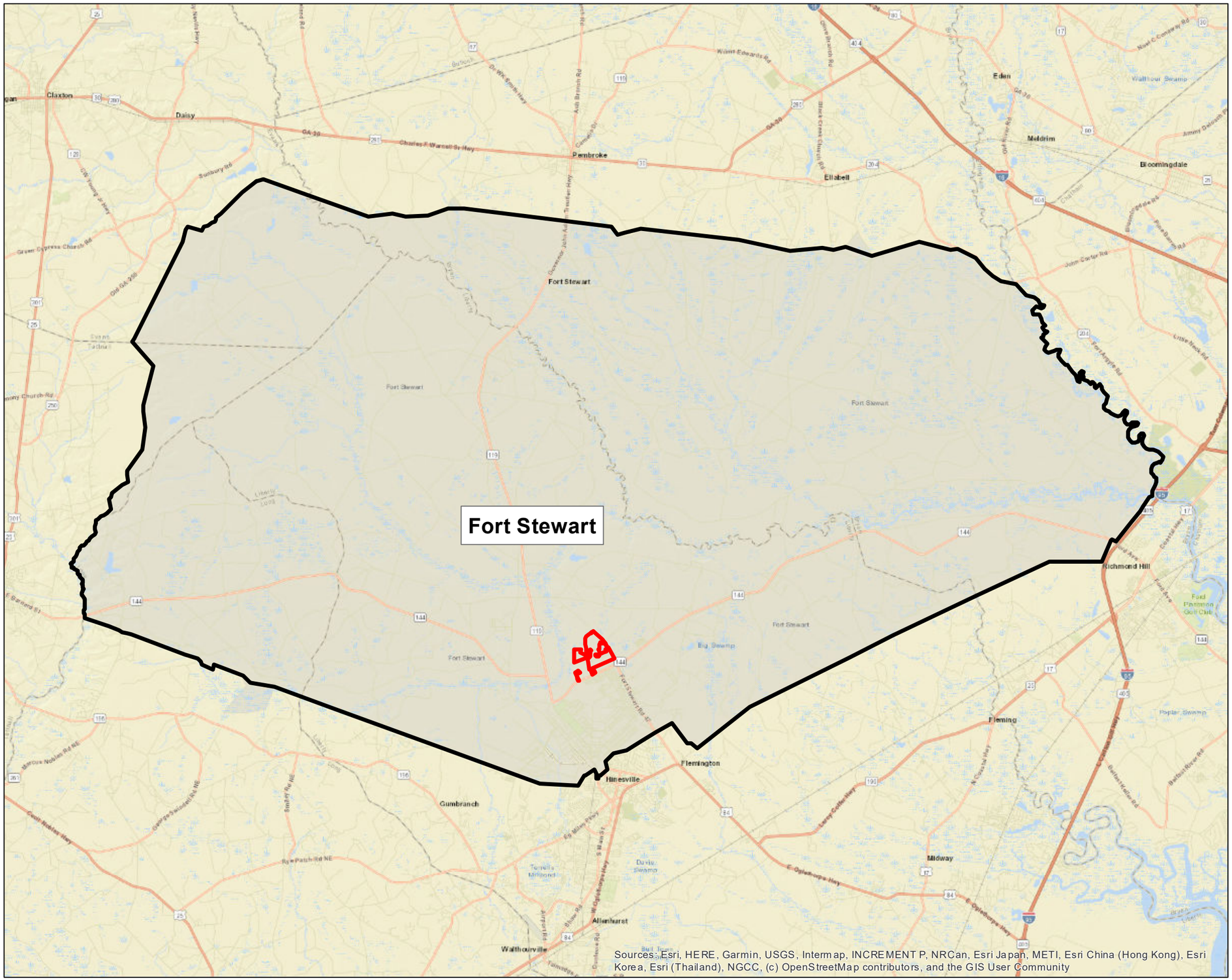
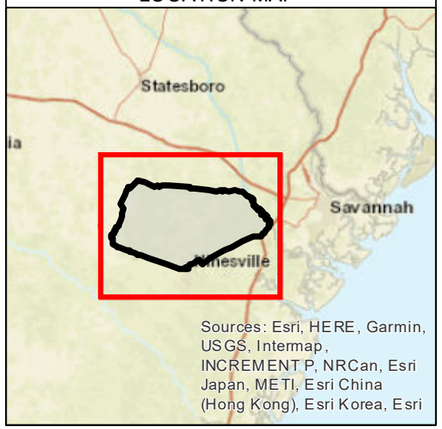
Figures



LEGEND

- Installation Boundary
- Anti-Aircraft Range 4A

LOCATION MAP



NOTES & SOURCES

Map Coordinates: WGS 1984, UTM Zone 17N (US Feet)

0 2.5 5

Miles

TITLE

Installation Map and Site Location

KEMRON ENVIRONMENTAL SERVICES

Fort Stewart

PROJECT: U.S. Army Garrison - Fort Stewart
Directorate of Public Works
1550 Veterans Parkway Building 1137
USAG Fort Stewart, Georgia 31314

DRAWING DATE: 4/24/2020

Drawn by:	Reviewed by:
CJ	MSC

N

FIGURE 1

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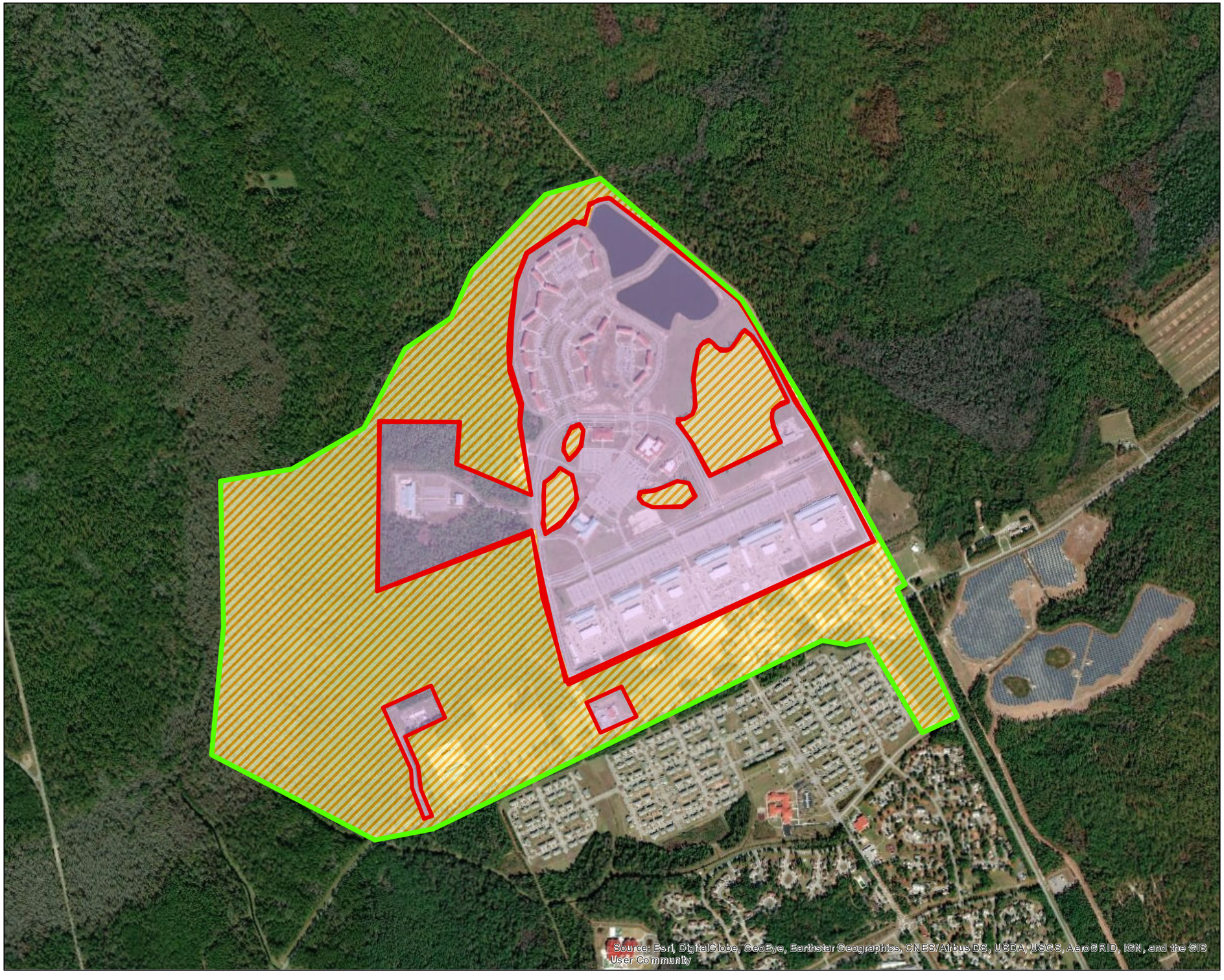
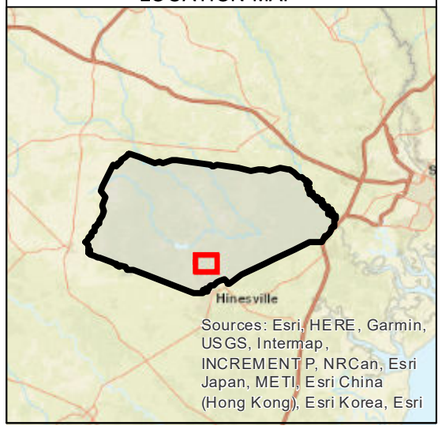


LEGEND

- Anti-Aircraft Range 4
- Anti-Aircraft Range 4A
- Anti-Aircraft Range 4B
- Installation Boundary

LOCATION MAP



NOTES & SOURCES

Map Coordinates: WGS 1984
UTM Zone 17N (US Feet)

Anti-Aircraft Range (AAR) 4 was previously divided into AAR-4A and AAR-4B (CB&I, 2018)

0 1,000 2,000
Feet

TITLE

Anti-Aircraft Range 4A Site Map

KEMRON ENVIRONMENTAL SERVICES — Fort Stewart

PROJECT: U.S. Army Garrison - Fort Stewart
Directorate of Public Works
1550 Veterans Parkway Building 1137
USAG Fort Stewart, Georgia 31314

DRAWING DATE: 5/19/2020

Drawn by: CJ | Reviewed by: MSC

N

FIGURE
2

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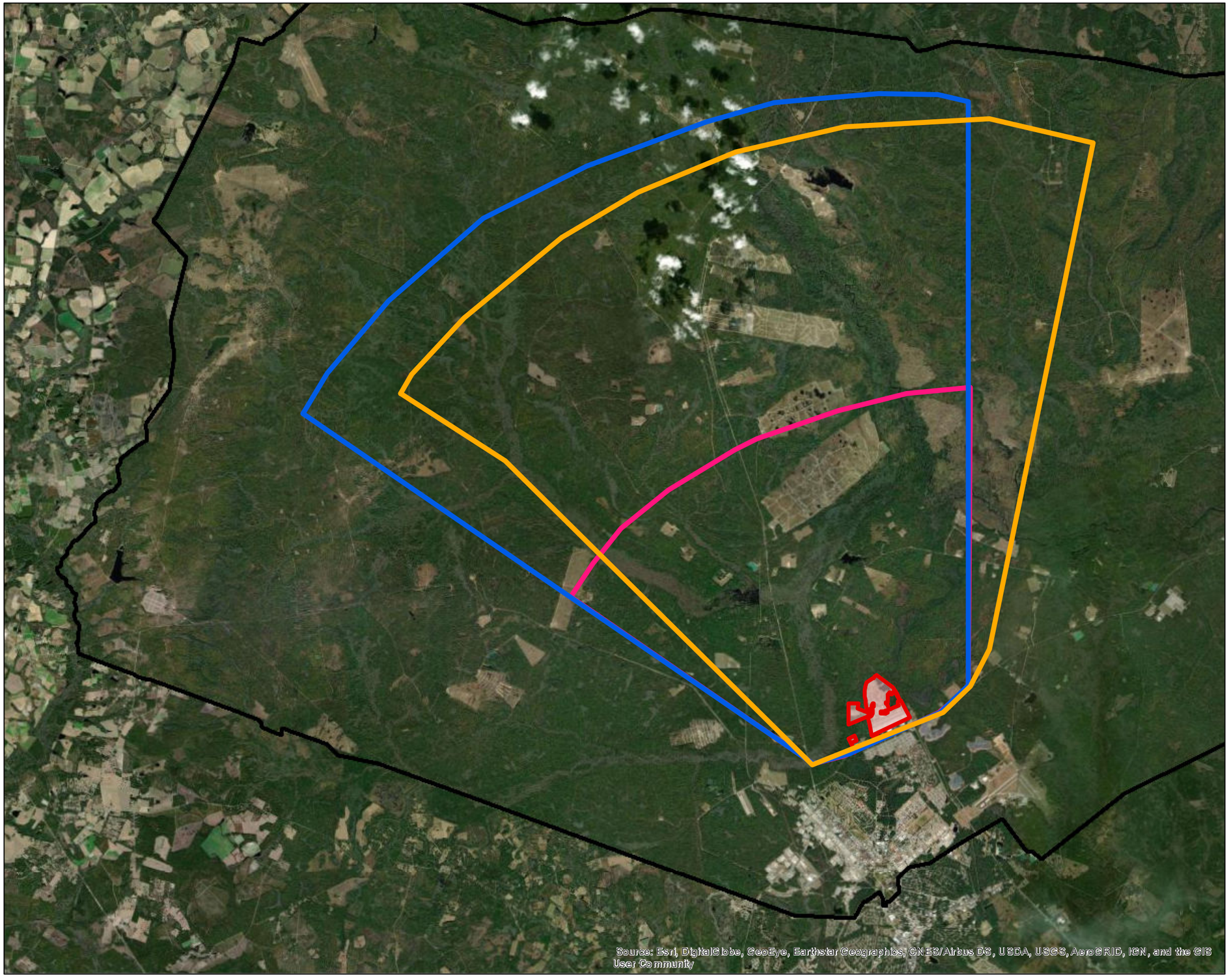
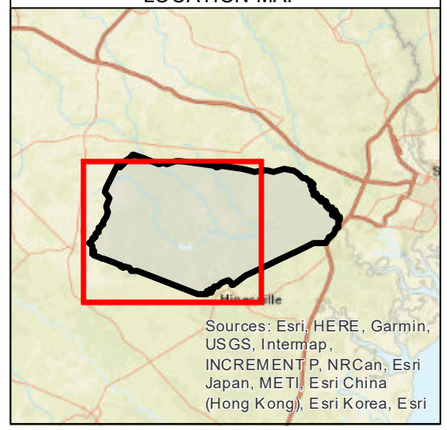


LEGEND

- 40mm Range C 11,850 yds
- 90mm Range 20,500 yds
- 90mm Range C
- Anti-Aircraft Range 4A
- Installation Boundary

LOCATION MAP



NOTES & SOURCES

Map Coordinates: WGS 1984
UTM Zone 17N (US Feet)

Range fans as depicted in
RFI (CBI, 2018)

0 7,500 15,000

Feet

TITLE

Anti-Aircraft Range 4A
Historic Range Fans

KEMRON ENVIRONMENTAL SERVICES

Fort Stewart

PROJECT: U.S. Army Garrison - Fort Stewart
Directorate of Public Works
1550 Veterans Parkway Building 1137
USAG Fort Stewart, Georgia 31314

DRAWING DATE: 5/14/2020

Drawn by:	Reviewed by:
CJ	MSC

N

FIGURE

3

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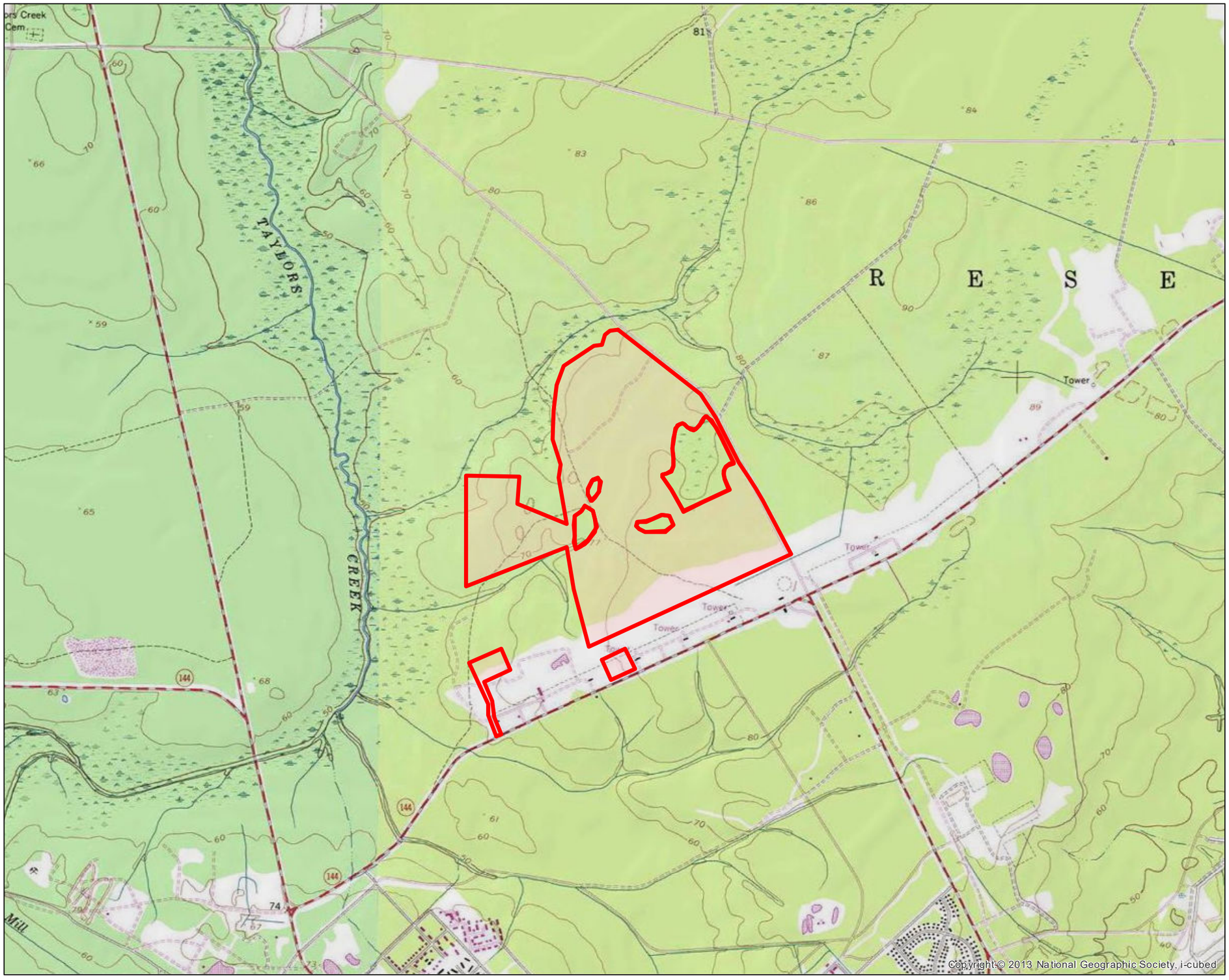
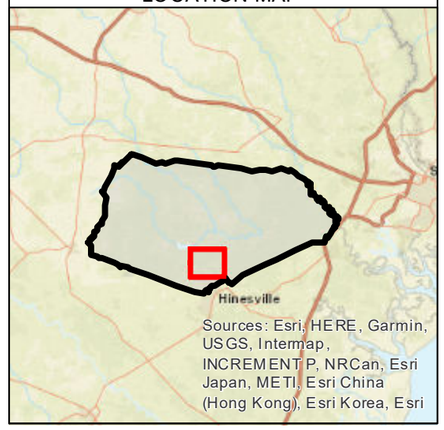


LEGEND

- Anti-Aircraft Range 4A
- Installation Boundary

LOCATION MAP



NOTES & SOURCES

Map Coordinates: WGS 1984, UTM Zone 17N (US Feet)

0 0.25 0.5

Miles

TITLE

Anti-Aircraft Range 4A Topography

KEMRON ENVIRONMENTAL SERVICES

Fort Stewart

PROJECT: U.S. Army Garrison - Fort Stewart
Directorate of Public Works
1550 Veterans Parkway Building 1137
USAG Fort Stewart, Georgia 31314

DRAWING DATE: 5/19/2020

Drawn by:	Reviewed by:
CJ	MSC

N

FIGURE

4

Document Path: L:\GIS_Databases\GIS\SH4943 - Ft Stewart Hunter Army Airfield\Fort Stewart\MXDs\4A\4-4A_topo.mxd

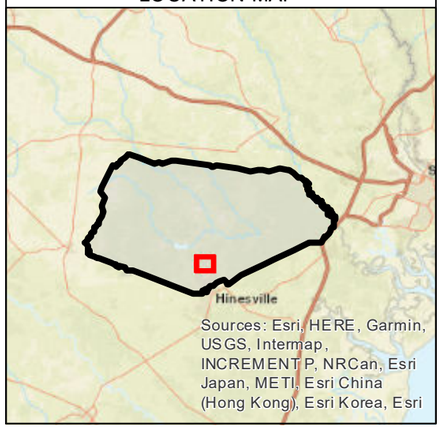
LEGEND

- Anti Aircraft Range 4A/4B Boundary
- AntiAircraft Range 4B

Investigation

- BSEn TCRAs
- USACE MEC QA: Shoppette
- USACE QA Follow On: ICBT
- USACE QA: ICBT

LOCATION MAP



NOTES & SOURCES

Map Coordinates: WGS 1984, UTM Zone 17N (US Feet)
MRS boundaries from CB&I, 2018.
Extent of previous investigations from:
BSEn, 2011 a-g
USACE, 2011a-c
See Text for full Reference Information

0 0.25 0.5
Miles

TITLE

Anti-Aircraft Range 4A
Extent of Previous Investigations

KEMRON ENVIRONMENTAL SERVICES — Fort Stewart

PROJECT: U.S. Army Garrison - Fort Stewart
Directorate of Public Works
1550 Veterans Parkway Building 1137
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FIGURE
5

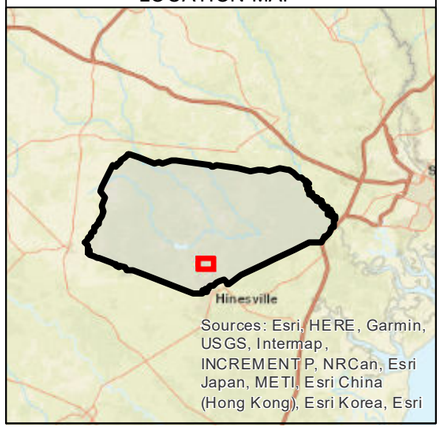
Document Path: L:\GIS_Databases\GIS\SH4943 - Ft Stewart Hunter Army Airfield\Fort Stewart\MXDs\4A\5- FTSW_4A_Extent_hist.mxd

LEGEND

Proposed Signs

Existing Range 4A Fence

LOCATION MAP



NOTES & SOURCES

Map Coordinates: WGS 1984, UTM Zone 17N (US Feet)

Sign placement is based on 200 ft spacing. Signs will be fence-mounted where possible.

0 1,000 2,000

Feet

TITLE

Anti-Aircraft Range 4A
Alternative 2
LUCs

KEMRON ENVIRONMENTAL SERVICES

Fort Stewart

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Directorate of Public Works
1550 Veterans Parkway Building 1137
USAG Fort Stewart, Georgia 31314

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FIGURE

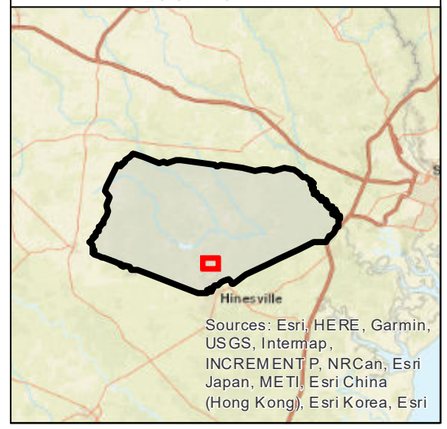
6

Document Path: L:\GIS_Databases\GIS\SH4943 - Ft Stewart Hunter Army Airfield\Fort StewartMXDs\4A\6-FTSW_4A_Alternative2.mxd

LEGEND

- Anti-Aircraft Range 4A/4B Boundary
- Areas for Subsurface Clearance
- Previous Investigations/ Construction/ Removal Actions
- Anti-Aircraft Range 4B
- Installation Boundary

LOCATION MAP



NOTES & SOURCES

Map Coordinates: WGS 1984
UTM Zone 17N (US Feet)
Extent of Previous Investigations derived from figures in prior reports, see text and references for further information and for explanation of areas requiring clearance.

0 1,000 2,000

Feet

TITLE

Anti-Aircraft Range 4A
Alternative 3
MEC Subsurface Clearance

KEMRON ENVIRONMENTAL SERVICES

Fort Stewart

PROJECT: U.S. Army Garrison - Fort Stewart
Directorate of Public Works
1550 Veterans Parkway Building 1137
USAG Fort Stewart, Georgia 31314

DRAWING DATE: 5/19/2020

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CJ	MSC

N

FIGURE

7

Document Path: L:\GIS_Databases\GIS\SH4943 - Ft Stewart Hunter Army Airfield\Fort Stewart\MXDs\4A\7-FTSW_4A_Alternative3.mxd

Appendix A – Support for Cost Estimate

Table A-1: Anti-Aircraft Range 4A
Alternative 1: No Action

Capital Costs					
Description	**Quantity**	**Units**	**Unit Cost**	**Total Cost**	**Notes/Assumptions**
Statement of Basis					
Statement of Basis and Response to Comments	1	LS	$15,000	$15,000	Includes Public Review and Meeting
SUBTOTAL (Statement of Basis)				$15,000	
Contingency (% of Sum)	12%			$1,800	
Project Management (% of Sum + Cont.)	8%			$1,344	
Total Capital Cost				**$18,144**	

Annual Costs
There are no annual costs associated with this Alternative

Periodic Costs
There are no periodic costs associated with this Alternative

Present Value Analysis					
Cost Type	**Year**	**Total Cost**	**Total Cost Per Year**	**Discount Factor (7%)**	**Present Value**
Capital	0	$18,144	$18,144	1.000	$18,144
Annual	1-30	$0	$0	12.409	$0
Periodic	NA	$0	$0	NA	$0
Total Present Value of Alternative					**$18,144**

Table A-2: Anti-Aircraft Range 4A
Alternative 2: Land Use Controls

Capital Costs					
Description	**Quantity**	**Units**	**Unit Cost**	**Total Cost**	**Notes/Assumptions**
Statement of Basis					
Statement of Basis and Response to Comments	1	LS	$15,000	$15,000	Includes Public Review and Meeting
SUBTOTAL (Statement of Basis)				$15,000	
Land Use Controls					
Land Use Control Implementation Plan	1	LS	$20,000	$20,000	Includes design and placement of fence and signs, details required institutional controls
Sign Installation	1	LS	$18,450	$18,450	
Institutional Controls	1	LS	$15,000	$15,000	Incorporating land use restrictions into all applicable documents
SUBTOTAL (Land Use Controls)				$53,450	
SUBTOTAL (All Activities)				$68,450	
Contingency (% of Sum)	10%			$6,845	
Project Management (% of Sum + Cont.)	5%			$3,765	
Construction Management (% of Sum + Cont.)	3%			$1,809	Excludes Statement of Basis
Total Capital Cost				**$80,869**	

Annual Costs					
Description	**Quantity**	**Units**	**Unit Cost**	**Total Cost**	**Notes/Assumptions**
Fence and Sign Maintenance	1	LS	$1,474	$1,474	Replace missing and/or repair damaged fence and signs annually for 30 years
LUC Status Report	1	LS	$1,500	$1,500	Annual Report for GA EPD
SUBTOTAL				$2,974	
Contingency (% of Sum)	10%			$297	
Project Management (% of Sum + Cont.)	5%			$164	
Total Annual Cost				**$3,435**	

Table A-2: Anti-Aircraft Range 4A
Alternative 2: Land Use Controls

Periodic Costs						
Description	**Year**	**Quantity**	**Units**	**Unit Cost**	**Total Cost**	**Notes/Assumptions**
Periodic Review Reports	See note	1	LS	$55,000	$55,000	Preparation of report at end of years 5, 10, 15, 20, 25, and 30
SUBTOTAL					$55,000	
Contingency (% of Sum)		12%			$6,600	
Project Management (% of Sum + Cont.)		8%			$4,928	
Total Periodic Costs					**$66,528**	

Present Value Analysis					
Cost Type	**Year**	**Total Cost**	**Total Cost Per Year**	**Discount Factor (7%)**	**Present Value**
Capital	0	$80,869	$80,869	1.000	$80,869
Annual	1-30	$103,049	$3,435	12.409	$42,625
Periodic	5	$66,528	$66,528	0.713	$47,434
Periodic	10	$66,528	$66,528	0.508	$33,819
Periodic	15	$66,528	$66,528	0.362	$24,113
Periodic	20	$66,528	$66,528	0.258	$17,192
Periodic	25	$66,528	$66,528	0.184	$12,258
Periodic	30	$66,528	$66,528	0.131	$8,740
Total Present Value of Alternative					**$267,049**

Table A-3: Anti-Aircraft Range 4A
Alternative 3: MEC Clearance

Capital Costs					
Description	**Quantity**	**Units**	**Unit Cost**	**Total Cost**	**Notes/Assumptions**
Statement of Basis					
Statement of Basis and Response to Comments	1	LS	$15,000	$15,000	Includes Public Review and Meeting
SUBTOTAL (Statement of Basis)				$15,000	
MEC Clearance					
Planning Documents	1	LS	$48,000	$48,000	Explosive Safety Submission, Work Plan, Accident Prevention Plan
Mobilization/Demobilization	1	LS	$26,000	$26,000	Personnel and equipment
Surface Clearance	1	LS	$220,800	$220,800	
DGM	1	LS	$165,400	$165,400	
Intrusive Investigation	1	LS	$289,000	$289,000	
Demolition	1	LS	$8,000	$8,000	
Disposal	1	LS	$2,200	$2,200	
Completion Report	1	LS	$30,000	$30,000	
SUBTOTAL (MEC Clearance)				$789,400	
SUBTOTAL				$804,400	
Contingency (% of Sum)	12%			$96,528	
Project Management (% of Sum + Cont.)	8%			$72,074.24	
Remedial Design (% of Sum + Cont.)	5%			$44,296.40	Excludes Statement of Basis
Construction Management (% of Sum + Cont.)	6%			$53,155.68	Excludes Statement of Basis
Total Capital Cost				**$1,070,454**	

Annual Costs
There are no annual costs associated with this Alternative following completion of MEC Clearance

Periodic Costs
There are no periodic costs associated with this Alternative following completion of MEC Clearance

Table A-3: Anti-Aircraft Range 4A
Alternative 3: MEC Clearance

Present Value Analysis					
Cost Type	**Year**	**Total Cost**	**Total Cost Per Year**	**Discount Factor (7%)**	**Present Value**
Capital	0	$1,070,454	$1,070,454	1.000	$1,070,454
Annual	1-30	$0	$0	12.409	$0
Periodic	NA	$0	$0	NA	$0
Total Present Value of Alternative					**$1,070,454**