Revised Final

RCRA Facility Investigation Work Plan for Four MMRP Sites:

Anti-Aircraft Range - 4A
Anti-Aircraft Range - 4B
Anti-Tank Range 90-MM-2
Grenade Launcher Range
at Fort Stewart, Hinesville, Georgia

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RCRA FACILITY INVESTIGATION WORK PLAN
FOR
FOUR MILITARY MUNITIONS RESPONSE PROGRAM SITES:

ANTI-AIRCRAFT RANGE - 4A
ANTI-AIRCRAFT RANGE - 4B
ANTI-TANK RANGE 90-MM-2
GRENADE LAUNCHER RANGE
AT
FORT STEWART

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REVISED FINAL DOCUMENT

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LIST OF ACRONYMS AND ABBREVIATIONS

1D....................one dimensional
2D....................two dimensional
3ID...................3rd Infantry Division
AP....................Armor-Piercing
APP..................Accident Prevention Plan
ASCII................American Standard Code for Information Interchange
ATF...................Bureau of Alcohol, Tobacco, and Firearms
bgs...................below ground surface
BIP...................Blow-In-Place
BSEn................Bering Sea Environmental
CB&I.................CB&I Federal Services LLC
CENAB.............USACE, Baltimore District
CERCLA...........Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR..................Code of Federal Regulations
CHE..................Chemical Warfare Material Hazard Evaluation
cm....................centimeters
CMS.................Corrective Measures Study
CMUA...............Concentrated Munitions Use Area
COC.................Chemical of Concern
COPC...............Chemical of Potential Concern
COPEC.............Chemical of Potential Ecological Concern
CS....................Confirmatory Sampling
CSM.................Conceptual Site Model
CWM................Chemical Warfare Materiel
DDESB.............Department of Defense Explosives Safety Board
DERP...............Defense Environmental Restoration Program
DFW.................Definable Feature of Work
DGM.................Digital Geophysical Mapping
DID...................Data Item Description
DMM.................Discarded Military Munitions
DoD..................U.S. Department of Defense
DPW.................Directorate of Public Works
DQCR...............Daily Quality Control Report
DQO.................Data Quality Objective
DS....................Demolition Supervisor
EHE..................Explosive Hazard Evaluation
EIMS.................Environmental Information Management System
EM....................Engineer Manual
ENRD...............Environmental and Natural Resources Division
EOD..................Explosive Ordnance Disposal
EPC..................Exposure Point Concentration
EPP..................Environmental Protection Plan
ER....................Engineer Regulation
ERA..................Ecological Risk Assessment
ERDC...............U.S. Army Engineer Research and Development Center
ESA..................Endangered Species Act
ESP..................Explosives Siting Plan
ESV..................Ecological Screening Value
EZ.....................Exclusion Zone
FTSW...............Fort Stewart
GA....................Georgia
GAEPD.............Georgia Environmental Protection Division
GIS...................Geographic Information System

GPS..................Global Positioning System
HA ....Hazard Assessment
HFD..................Hazardous Fragment Distance
HHE..................Health Hazard Evaluation
HI......................Hazard Index
HQ....................Hazard Quotient
HRR..................Historical Records Review
HSM ....Health and Safety Manager
IBCT ....Infantry Brigade Combat Team
ID......................Identification
ILCR ....Individual Lifetime Cancer Risk
INRMP..............Integrated Natural Resource Management Plan
IRIS ....Integrated Risk Information System
ISO ....Industry Standard Object
IVS....................Instrument Verification Strip
LUC ....Land Use Control
m/s....................meters per second
MAMMS............Multiple Award Military Munitions Services
MC....................Munitions Constituents
MCL..................Maximum Contaminant Level
MDAS...............Material Documented as Safe
MDC ....Maximum Detected Concentration
MDEH...............Material Documented as an Explosive Hazard
MEC ....Munitions and Explosives of Concern
MGFD...............Munition with the Greatest Fragmentation Distance
mg/kg................milligrams per kilogram
mm ....millimeters
MMRP ....Military Munitions Response Program
MPPEH.............Material Potentially Presenting an Explosive Hazard
MQO.................Measurement Quality Objective
MRA ....Munitions Response Area
MRS ....Munitions Response Site
MRSPP.............Munitions Response Site Prioritization Protocol
MSD ....Minimum Separation Distance
msl....................mean sea level
mV....................millivolts
NCP..................National Oil and Hazardous Substances Pollution Contingency Plan
NEW.................Net Explosive Weight
NFA ....No Further Action
NRL ....Naval Research Laboratory
OE ....Ordnance and Explosives
PDA..................Personal Data Assistant
PDF ....Portable Document Format
PDT ....Project Delivery Team
PM....................Project Manager
PMP..................Project Management Plan
PPRTV ....Provisional Peer-Reviewed Toxicity Value
QA ....Quality Assurance
QC....................Quality Control
QCP..................Quality Control Plan
QSM ....Quality Systems Manual
RA ....Removal Action
RCRA ....Resource Conservation and Recovery Act
RfC ....Reference Concentration
RfD ....Reference Dose
RFI....................RCRA Facility Investigation

RL....................Reporting Limit
RSL ....Regional Screening Level
RTK ....Real-Time Kinetic
RTS ....Robotic Total Station
SAP ....Sampling and Analysis Plan
SLERA.............Screening Level Ecological Risk Assessment
SOW................Statement of Work
SSHP...............Site Safety and Health Plan
SSL..................Soil Screening Level
SUXOS............Senior Unexploded Ordnance Supervisor
TCRA...............Time Critical Removal Action
TP....................Technical Paper
UCL ....Upper Confidence Limit
UFP-QAPP.......Uniform Federal Policy for Quality Assurance Project Plans
USACE............U.S. Army Corps of Engineers
USAEC............U.S. Army Environmental Command
USC.................United States Code
USEPA............U.S. Environmental Protection Agency
UTL..................Upper Tolerance Limit
UTM.................Universal Transverse Mercator
UXO.................Unexploded Ordnance
UXOQCS..........Unexploded Ordnance Quality Control Specialist
UXOSO ....Unexploded Ordnance Safety Officer
VSP ....Visual Sample Plan

1.0 INTRODUCTION

This work plan describes the activities planned to perform a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the following four Munitions Response Sites (MRSs) located at Fort Stewart (FTSW) in Hinesville, Georgia (GA):

- Anti-Aircraft Range - 4A (FTSW-009-R-01)
- Anti-Aircraft Range - 4B (FTSW-009-R-02)
- Anti-Tank Range 90-MM-2 (FTSW-010-R-01)
- Grenade Launcher Range (FTSW-011-R-01)

The location of FTSW and the four MRSs is shown on **Figure 1-1** and **Figure 1-2**, respectively.

CB&I Federal Services LLC (CB&I) prepared this work plan under contract to U.S. Army Corps of Engineers (USACE), Baltimore District (CENAB), Multiple Award Military Munitions Services (MAMMS), Contract W912DR-09-D-0005, Task Order 0005.

1.1 PROJECT AUTHORIZATION

The U.S. Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) to address DoD sites suspected of containing Munitions and Explosives of Concern (MEC) or Munitions Constituents (MC).

Pursuant to the DoD Manual for Defense Environmental Restoration Program (DERP) Management (DoD, 2012a), DoD primarily conducts MMRP response activities in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S. Code §9620), Executive Orders 12580 and 13016, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] Part 300). At FTSW, this work is performed under RCRA (42 U.S. Code §6901 et seq [1976]) rather than CERCLA. While not all MEC or MC constitutes RCRA or CERCLA hazardous substances, pollutants, or contaminants, the DERP statute provides the DoD with the authority to respond to releases of MEC and MC. DoD policy states that such responses shall be conducted in accordance with RCRA, CERCLA, and the NCP.

The RFI will be developed and performed in accordance with FTSW's RCRA Part B Permit No. HW-045 (S) issued by the Georgia Environmental Protection Division (GAEPD) on 14 August 2007. This permit will be in force until termination on 14 August 2017. Regulatory coordination will occur through FTSW, solely with the GAEPD. The U.S. Environmental Protection Agency (USEPA) Region 4 has deferred its involvement on this project and empowered the state with regulatory authority.

1.2 PURPOSE AND SCOPE

The overall purpose of this work is to conduct an RFI at the four FTSW MRSs listed above due to the presence of MEC and MC. More specifically, the RFI will:

- Determine the nature and extent of MEC
- Determine the presence/absence of MC
- Determine the hazards and risk posed to human health and the environment by MEC and MC

Additionally, the data collected for this RFI will be used to support a Corrective Measures Study (CMS) that will evaluate corrective measures alternatives.

1.3 WORK PLAN ORGANIZATION

The contents and order of presentation of this work plan are based on the requirements of Data Item Description (DID) MR-001. Specifically, this work plan includes the following sections:

- Section 1.0—Introduction
- Section 2.0—Technical Management Plan

- Section 3.0—Field Investigation Plan
- Section 4.0—Quality Control Plan (QCP)
- Section 5.0—Explosives Management Plan
- Section 6.0—Explosives Siting Plan (ESP)
- Section 7.0—Environmental Protection Plan (EPP)
- Section 8.0—Property Management Plan
- Section 9.0—Interim Holding Facility Siting Plan for Recovered Chemical Warfare Materiel Projects (not applicable to this project)
- Section 10.0—Physical Security Plan for Recovered Chemical Warfare Materiel Project Sites (not applicable to this project)
- Section 11.0—References (guidance, regulations, and other policies)

Appendices A through I include the Task Order Statement of Work (SOW), site maps, local points of contact, CB&I forms, minimum separation distance (MSD) information, project personnel resumes, Technical Project Planning minutes, Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP), and proposed transects and proposed grids. The Accident Prevention Plan (APP) will be submitted as a separate document.

1.4 PROJECT LOCATION

FTSW is located in Hinesville, GA, approximately 40 miles southwest of Savannah, GA (**Figure 1-1**). FTSW is 279,081 acres in size and covers portions of Bryan, Evans, Liberty, Long, and Tattnall counties (**Figure 1-2**). The Installation, which is the largest Army installation east of the Mississippi River, is bisected by Georgia Highway 119 and Georgia Highway 144.

1.5 SITE DESCRIPTION

1.5.1 Topography

The majority of FTSW consists of flat land, with surface elevations varying from approximately 2 to 30 meters above mean sea level (msl). In the northwestern portion of the FTSW, the topography consists of rolling hills with elevations ranging from 30 to 55 meters above msl (Arcadis/Malcolm Pirnie, Inc., 2011). The MRSs included in this work plan consist of relatively flat terrain. **Figure 1-3** presents the topography at the FTSW MRSs.

1.5.2 Climate

The climate at FTSW is classified as humid subtropical, and the region is characterized by well-defined seasons with hot, humid, summers, and mild winters. The National Oceanic and Atmospheric Administration identified the average annual precipitation for Fort Stewart, GA, as 48.32 inches, with November as the driest month and July as the wettest month. **Table 1-1** reflects the annual climate and weather normally encountered at FTSW.

1.5.3 Vegetation

Within FTSW, four types of ecosystems are present: sand hills, pine flatwoods, upland forests, and wetlands. The breakdown of ecosystems at FTSW is as follows: 57 percent upland forest, 29 percent forested wetlands, and 14 percent cleared areas. The MRSs included in this work plan contain forests, wetlands, and developed areas. Approximately 82,148 acres of wetlands have been identified on FTSW, which represents approximately 30 percent of the total area (see **Figure 7-1**). Wetland types identified at FTSW include black water swamps, bay forests, stream head pocosins, wet pine flat woods, and cypress-gum swamps. The following wetlands acreages are present within each MRS.

MRS	Wetlands (acres)
Anti-Aircraft Range - 4B	239.3
Anti-Tank Range 90-MM-2	73.4
Grenade Launcher Range	6.6

Major tree species located within FTSW include longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), loblolly pine (*Pinus taeda*), tupelo (*Nyssa sylvatica*), other gums (*Nyssa spp*.), water oak (*Quercus nigra*), and bald cypress (*Taxodium distichum*) (Arcadis/Malcolm Pirnie, 2011).

Table 1-1
Climatic Information, Fort Stewart, Georgia

Temperature Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Normal Max Temperature (°F)	62.4	66.4	73.5	79.8	86.0	90.6	93.3	91.3	87.3	79.8	72.0	64.2
Normal Min Temperature (°F)	40.7	42.8	48.7	54.1	62.2	68.7	71.8	71.4	67.8	57.7	49.5	42.7
Mean Precipitation (inches)	4.28	3.32	3.76	2.98	3.45	5.06	5.92	5.84	4.79	3.17	2.69	3.06

Source: National Oceanic and Atmospheric Administration Climatography of the United States No. 81 1971-2000. http://hurricane.ncdc.noaa.gov/climatenormals/clim81/GAnorm.pdf

1.5.4 Site Geology and Soil Type

The geology of coastal Georgia dates back to the Paleozoic epoch. Within the sedimentary section, 700 meters of Paleozoic rocks of Late Devonian age are overlain by 2300 meters of Early and Late Cretaceous sediments from the Mesozoic era. Crestaceous rocks are overlain by 100 meters of Cenozoic sediments (Arcadis/Malcolm Pirnie, 2011).

FTSW lies within the Southern Coastal Plain physiographic province. The province is characterized by a wedge of gentle, southeast-dipping, clastic sediments, which cover crystalline basement rock. The unconsolidated clastic sediments, which consist of sand, silt, and clay, thicken in an easterly direction. Underneath the clastic sediments, the basement rocks are located. This complex consists of metamorphic and igneous rocks that range in age from Precambrian to Triassic. The basement complex dips coastward at about 5.7 meters per kilometer from the Fall Line, which is located near Macon and Augusta, GA, to near the surface in the Savannah, GA, area (Arcadis/Malcolm Pirnie, 2011).

The most common soil series at FTSW are Ellabelle loamy sand, Ogeechee, Pelham, Stilson, Rutlege, Leefield, and Mascotte. These soil series are poorly drained. The majority of the soils present contain a sandy surface layer overlying subsurface soil that may consist of sand, clay, loam, or a combination thereof. Although there is a general lack of cohesive clays in the surface soils that could make these soils more prone to erosion, all the MRSs are relatively flat with good vegetative cover, so the soils are not particularly subject to erosion. **Figure 1-4** presents the soil types present at the Installation. Soil types in each MRS are as follows:

- Anti-Aircraft Range 4A—Pelham loamy sand, Albany loamy fine sand, Echaw and Centenary fine sands, Mandarin fine sand
- Anti-Aircraft Range 4B—Pelham loamy sand, Mandarin fine sand, Osier and Bibb soils, Mascotte fine sand, Leefield loamy sand, Johnston and Bibb soils
- Anti-Tank Range 90 MM 2—Pelham loamy sand, Albany loamy fine sand, Ellabelle loamy sand, Mascotte fine sand, Johnston and Bibb soils
- Grenade Launcher Range—Pelham loamy sand, Mascotte fine sand

1.6 SITE HISTORY

On 10 September 1940, construction of a reservation began on the former Camp Savannah Anti-Aircraft Firing Center. The name of the reservation was changed from Camp Savannah to Camp Stewart on 18 November 1940. The reservation served as an anti-aircraft center that prepared artillery troops for deployment. During the spring of 1944, the reservation was home to 55,000 soldiers.

On 20 November 1944, the mission of training anti-aircraft units ended. In December 1944, all training was terminated. Army ground forces units departed by 30 April 1945 and a prisoner-of-war camp was also closed. From 6 August 1945 until 2 September 1945, the reservation served as a separation center for redeployed troops. Camp Stewart was inactivated on 30 September 1945. The reservation became the training location for the Georgia National Guard. By the fall of 1945, 2 officers, 10 enlisted men, and 50 civilian employees remained at the reservation in order to maintain the facilities.

In order to support the Korean War, Camp Stewart was reactivated on 9 August 1950. The reservation was designated as the 3rd Army Anti-Aircraft Artillery Training Center. In 1953, the mission of the reservation was expanded to include armor and tank training. On 21 March 1956, Camp Stewart was re-designated as Fort Stewart and designated a permanent Army Installation. In 1959, FTSW became an armor and artillery firing center. During the Cuban Crisis of 1962, the 1st Armored Division was relocated to FTSW. Training at FTSW peaked during this time.

Due to the need for more helicopter and light fixed wing aircraft during the Vietnam Conflict, a portion of the U.S. Army Aviation School at Fort Rucker, Alabama, was transferred to FTSW in 1966. The new mission for FTSW included helicopter pilot training and helicopter gunnery courses.

In 1967, the main mission for FTSW was to train Army aviators. Active duty, Reserve, and National Guard personnel were also stationed at FTSW to maintain readiness. Vietnamese helicopter pilots began training at FTSW in 1970. In 1973, all aviation training was consolidated at Fort Rucker. By 1974, FTSW became a training and maneuver area for Army and National Guard Units. Training activities included: tank, field artillery, helicopter gunnery, and small arms. In 1974, the 1st Battalion, 75th Infantry Regiment (Ranger) and the 24th Infantry Division were activated at FTSW.

Currently, FTSW, along with Hunter Army Airfield, is home of the 3rd Infantry Division (3ID). Major units located at FTSW include: 1st Brigade, 3ID; 2nd Brigade, 3ID; 3ID Artillery; 3ID Support Command; 3ID Engineer Brigade; 3/7 Cavalry; 1/3 Air Defense Artillery; 103d Military Intelligence Battalion; 123d Signal Battalion; 3d Military Police Battalion (Provisional); and 24th Corps Support Groups. The 3d Brigade, 3ID operates out of Fort Benning, GA, but often trains at FTSW. The mission of FTSW is to sustain a quality of life and reservation support at the level necessary for divisions and non-divisional, tenant, and Reserve Component units to accomplish their training missions (Arcadis/Malcolm Pirnie, 2011).

The following text includes brief site descriptions for the FTSW MRSs addressed under this work plan.

<u>Anti-Aircraft Range - 4A and 4B</u>

The Anti-Aircraft Range - 4A and 4B together represent the firing points and vicinity of three overlapping 40mm and 90mm anti-aircraft ranges that fired to the north, with range fans extending well beyond the MRSs into the Operational Range of FTSW (**Figure 1-5**). The ranges were used for training from 1941 to 1964. The 40mm and 90mm anti-aircraft guns fired at M2 target rockets and/or towed aerial targets. Armor-Piercing (AP) projectiles would be solid steel, while fillers used may have included TNT or Comp B (TNT/RDX mixtures) according to technical data sheets. A summary of munitions types and fillers is included in the UFP-QAPP, Worksheet #10. Use of the range for other types of munitions was not identified in historical reports; although, isolated examples of 81mm mortars, 2.75-inch rockets, and M67 hand grenades have been found. The Anti-Aircraft Range - 4A consists of 465 acres where MEC investigations and removals were performed by CENAB. The Anti-Aircraft Range - 4B represents the 663 acres that remain undeveloped and largely uninvestigated. **Figure 1-6** presents the site details associated with the Anti-Aircraft Range - 4A and 4B.

Anti-Tank Range 90-MM-2

The Anti-Tank Range 90-MM-2 is a 546-acre MRS. The eastern portion of the MRS was historically used for firing 40mm anti-aircraft and 90mm anti-tank rounds from what is now covered with a motor pool and fueling station. The range was operational during the 1940s, with aerial photos of the time showing two ground scars spaced approximately 1,500 feet apart, assumed to represent two firing positions. There was a figure-eight shaped track observed in historical photos which was part of a mounted target system used for anti-aircraft training. AP projectiles would be solid steel, while fillers used may have included TNT or Comp B (TNT/RDX mixtures) according to technical data sheets. A summary of munitions types and fillers is included in the UFP-QAPP, Worksheet #10. Use of the range for other types of munitions was not identified in historical reports. The range fans extended well beyond the MRS into the Operational Range of FTSW (**Figure 1-7**). The western portion of the MRS partially overlaps small arms, grenade launcher, and 120mm anti-aircraft range fans that fired from slightly south of the MRS. **Figure 1-8** presents the site details associated with the MRS. As depicted on **Figure 1-8**, Anti-Tank Range 90-MM-2 is a separate MRS surrounding a RCRA permitted landfill known as Anti-Tank Range 90-MM (FTSW-003-R-01) MRS. Both Anti-Tank Range 90-MM and Anti-Tank Range 90-MM-2 were the same historical ranges. It was decided that Anti-Tank Range 90-MM continue to be monitored as part of the landfill under the RCRA program and no further action (NFA) be taken under the MMRP. Therefore, the Anti-Tank Range 90-MM-2 represents a new MRS that does not include the landfill.

Grenade Launcher Range

The Grenade Launcher Range is a 143-acre MRS that was used for anti-aircraft, anti-tank, grenade launcher, and small arms training during the 1940s. Three small arms ranges (H, B, and A) are located within the MRS, which consisted of numerous firing mounds. Range B was also used to fire 40mm practice grenades with grenade launchers into the Range B berm, located within the MRS. A 9.2-acre infiltration course is located within Range H, which included .30-cal machine gun firing and detonations of 1 pound blocks of TNT to simulate battle conditions. A firing point for 120mm anti-aircraft projectiles was also located on the western portion of the MRS. **Figure 1-9** shows the entire range fans associated with the MRS, and **Figure 1-10** presents the site details associated with the MRS.

1.7 CURRENT AND PROJECTED LAND USE

A large portion of FTSW consists of undeveloped, forested land and wetlands. The majority of FTSW is considered operational area. **Figure 1-2** shows the location and current status of each of the four MRSs included in this work plan. The current and projected future land use for each MRS is discussed below.

Anti-Aircraft Range - 4A

The Anti-Aircraft Range - 4A consists of recently developed residential and industrial areas. Facilities located within the MRS include: barracks, operations facilities, tactical equipment maintenance facilities, Brigade/Battalion Headquarters facility, a dog kennel, dining facility, a physical fitness center, and family care clinic. No changes in the land use are anticipated or planned.

Anti-Aircraft Range - 4B

The Anti-Aircraft Range - 4B is mostly undeveloped, forested land. Forested areas are habitat for game which are hunted for recreation (Arcadis/Malcolm Pirnie, 2011). The wetlands within Anti-Aircraft Range - 4B are fenced and restricted by signage due to the potential for MEC. The southern portion of the MRS is a non-residential portion of the cantonment area with a maintenance facility, an administration building, an Explosive Ordnance Disposal (EOD) facility, garden Plots utilized by FTSW residents, and a private equestrian club that leases from FTSW. No changes in the land use are anticipated or planned within the Anti-Aircraft Range - 4B.

Anti-Tank Range 90-MM-2

The majority of the Anti-Tank Range 90-MM-2 consists of forested areas and grasslands used as wildlife habitat. The MRS is also partially comprised of the non-residential cantonment area, including a motor pool, and a borrow area. The borrow area is still being used as such based on a 2014 site visit. The future status of the borrow area is uncertain and will be evaluated in the RFI report. The motor pool area within Anti-Tank Range 90-MM-2 site is fenced, and the cantonment area has 24-hour security (Arcadis/Malcolm Pirnie, 2011). No changes in the land use are anticipated or planned within the Anti-Tank Range 90-MM-2.

Grenade Launcher Range

The majority of the Grenade Launcher Range consists of the recently developed, non-residential portion of the cantonment area, which includes office buildings and warehouses. There are no fences restricting access to the Grenade Launcher Range once you are on base. The western portion of the MRS consists of undeveloped, forested land used as wildlife habitat. No changes in the land use are anticipated or planned within the Grenade Launcher Range.

1.8 PREVIOUS SITE INVESTIGATIONS

This section summarizes the investigations and actions that have been performed at FTSW that may pertain to the RFI MRSs.

1.8.1 Phase 2 Historical Records Review

The purpose of the June 2010 Historical Records Review (HRR) was to perform a detailed review of historical documents to document MMRP sites at FTSW. The Phase 2 HRR is a continuation of the initial HRR completed in September 2006 and covers the area recently removed from the operational footprint and no longer excluded from the MMRP. During the investigation, three new MRSs were identified: Anti-Tank Range 90-MM-2, Anti-Aircraft Range – 4, and Grenade Launcher Range.

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

During construction of the Infantry Brigade Combat Team (IBCT) site in 2009, MEC and material documented as safe (MDAS) items were observed. A MEC investigation was performed by CENAB to provide guidance on a path forward for the site, which is located within Anti-Aircraft Range - 4A. From 14-26 February 2011, CENAB conducted a mag and dig investigation at areas of interest within the construction site. During the investigation, over 2000 anomalies were investigated. One MEC item, a Point Detonating Fuze, 16 MDAS items, consisting of 15 M2 Target Rockets and one 3.5” rocket motor, and seven small arms were observed. Based on the findings during the MEC quality assurance (QA) investigation, it was recommended that construction continue with “low probability” construction support protocols. In addition, further investigation was recommended at the remaining areas within the construction site (USACE, 2011a). **Figure 1-11** presents the location of the CENAB previous investigation.

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

In April 2011, CENAB performed a Follow-On MEC investigation at the remaining areas within the construction site, which is located in Anti-Aircraft Range - 4A (**Figure 1-11**). From 11-29 April 2011, a mag and dig investigation was performed in the areas within the construction footprint that are not covered by soil piles, buildings, pavement, etc. or areas that were not investigated during the MEC QA investigation. During the investigation, over 3,300 anomalies were investigated. No MEC items were observed. MDAS items, consisting of 54 M2 Target Rockets, 19 M2 Target Rocket Motors, and two 81mm practice mortars, were removed. Based on the findings during the MEC QA investigation, it was recommended that construction continue with “low probability” construction support protocols (USACE, 2011b).

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

Prior to construction of the Army and Air Force Exchange Service Mini Mart, CENAB performed a mag and dig investigation to verify that the site was safe for construction activities (**Figure 1-11**). From 13-21 April 2011, the MEC investigation was performed on the 5-acre construction site, which is located in Anti-Aircraft Range - 4A. During the investigation, over 350 anomalies were investigated. A small pit (1.5 feet x 2 feet x 2 feet) that contained rusted out bodies of fuze shipping containers was observed. No additional MEC/MDAS was observed within the construction site. Based on the findings during the MEC investigation, it was recommended that construction site continue with “low probability” construction support protocols (USACE, 2011c).

1.8.5 Time Critical Removal Action 10th Engineer Battalion Site & Dog Kennel Site

From April through June 2011, Bering Sea Environmental (BSEn) completed a Time Critical Removal Action (TCRA) at the 10th Engineer Battalion, Dog Kennel Site, HHQ Site, and South Pond Site (**Figure 1-11**). All of these locations are located within the Anti-Aircraft Range - 4A. During the TCRA, one MEC item, a M79 90mm HE-T projectile, was observed. Additionally, numerous MDAS items were found, mostly M2 target rockets (BSEn, 2011).

1.8.6 Phase 2 Confirmatory Sampling Report

The Confirmatory Sampling (CS) Report evaluates the potential presence of historical munitions at each four MRSs. A MEC and MC investigation was performed in August 2010. The following text summarizes the investigation activities performed during the Phase 2 CS at the four MRSs included in this work plan and provides the CS conclusions and recommendations for each of the MRSs.

Anti-Aircraft Range - 4 – As part of the Phase 2 CS, a magnetometer-assisted visual survey was conducted in accessible, undeveloped areas of the munitions response area (MRA). During the visual survey, no evidence of MEC or MDAS was observed. In order to assess MC, four discrete surface soil samples were collected from randomly distributed locations and analyzed for select metals and explosives. All metals were detected below the Regional Screening Levels (RSLs) and the Region 4 Ecological Screening Values (ESVs). All samples were non-detect for explosives. Based on the numerous investigations performed at the MRA to date, the CS recommended the MRA be divided into two MRSs. The Anti-Aircraft Range - 4A includes the areas where investigations and removal activities were performed. The Anti-Aircraft Range - 4B includes the remainder of the MRA, which is mostly undeveloped, where removal actions have not occurred. The Phase 2 CS recommended both MRSs receive an RFI/CMS for MEC. **Figure 1-12** depicts the Phase 2 CS results at the Anti-Aircraft Range - 4.

Anti-Tank Range 90-MM-2 – As part of the Phase 2 CS, a magnetometer-assisted visual survey was conducted in approximately 10 percent of the undeveloped areas within the MRS (approximately 33 acres). During the visual survey, one MDAS item, an M16A1 anti-personnel mine, was observed. In addition, several concrete pads and a concrete structure were observed within the MRS. In order to assess MC, four discrete surface soil samples were collected and analyzed for select metals and explosives. Two samples were collected near the suspected firing lines; the other two samples were randomly placed. All samples were non-detect for explosives. Zinc was detected above the FTSW background level and the ESV in one sample. However, the zinc concentration is not believed to be associated with former munitions activities. All other metals were detected below the RSLs and ESVs. The Phase 2 CS recommended an RFI/CMS for MEC. **Figure 1-13** depicts the Phase 2 CS results at the Anti-Tank Range 90-MM-2.

Grenade Launcher Range – As part of the Phase 2 CS, a magnetometer-assisted visual survey was conducted in approximately 10 percent of the undeveloped areas within the MRS (approximately 4 acres). During the visual survey, pop flares, empty ammo cans, and expended small arms cartridges were observed. In addition, concrete backstops were observed in the MRS. An earthen berm was present in front of portions of the backstop. Wooden target frames were also observed behind the backstop. In order to assess MC, 14 discrete soil samples were collected and analyzed for select metals and explosives. Of the 14 samples, 6 samples were biased to berms and firing points. The remaining eight samples were randomly located throughout the MRS. All samples were non-detect for explosives. Lead was detected above the ESV in three samples. *However, the Phase 2 CS Report concluded that since the concentrations of lead were less than an order of magnitude above the established background levels, they were likely indicative of naturally occurring conditions and not evidence of an impact of the former land use. The maximum lead concentration detected was 61.4 milligrams per kilogram (mg/kg), which is below the USEPA RSL for residential soil of 400 mg/kg*.

1.9 INITIAL SUMMARY OF HAZARD FROM MUNITIONS AND EXPLOSIVES OF CONCERN

There are several documented findings of MEC/MDAS at FTSW. Historical documentation indicated that conventional munitions were used at FTSW. During the Phase 2 CS and previous investigations, MEC and MDAS items were found at the MRSs addressed in this work plan, including

40mm, 90mm, and 120mm projectiles, M2 target rockets, 81mm practice mortars, M67 hand grenades, 40mm practice grenades, 2.75” and 3.5” rockets, and M16A1 anti-personnel mines. In addition, small arms ammunition has been observed at the MRSs. Based on this information, MEC and MDAS may be present at each MRS.

FTSW is readily accessible via multiple roads. Georgia Highway 119 and Georgia Highway 144 bisect FTSW. The Installation is also accessible by Interstate 16 and Interstate 95. Human receptors that have the potential to come in contact with MEC include: residents, authorized installation personnel, visitors, and trespassers.

The Munitions Response Site Prioritization Protocol (MRSPP) ranking applies to all four MRSs and was included as part of the Phase 2 CS conducted at FTSW. The Explosive Hazard Evaluation (EHE) factors include the details of the hazard, accessibility to the MRS, and receptor information. The Chemical Warfare Material Hazard Evaluation (CHE) evaluated the history of chemical warfare materiel (CWM) use at the individual site. The Health Hazard Evaluation (HHE) included an evaluation of MC and any non-munitions-related incidental contaminants present, receptor information, and details pertaining to environmental migration pathways.

Each MRS priority was then determined by comparing the EHE, CHE, and HHE ratings. The MRSPP priority can range from 1 to 8, with 1 indicating the highest potential hazard and 8 indicating the lowest potential hazard. These MRSPP scores are then used to help sequence future MRS response actions. The MRSPP performed during the FTSW Phase 2 CS resulted in an overall MRS Priority between 3 and 5 based on the three hazard evaluation modules, summarized in **Table 1-2**.

Table 1-2
MRSPP Summary, Fort Stewart, Georgia

MRS Name	EHE Module Rating	CHE Module Rating	HHE Module Rating	Overall Priority Rating
Anti-Aircraft Range – 4A	3	No Known or Suspected CWM Hazard	No Known or Suspected MC Hazard	3
Anti-Aircraft Range – 4B	3	No Known or Suspected CWM Hazard	No Known or Suspected MC Hazard	3
Anti-Tank Range 90-MM-2	5	No Known or Suspected CWM Hazard	8	5
Grenade Launcher Range	4	No Known or Suspected CWM Hazard	8	4

2.0 TECHNICAL MANAGEMENT PLAN

2.1 PROJECT OBJECTIVES

The overall purpose of this work is to conduct an RFI for four MRSs at FTSW due to the historical use of the MRSs and the potential presence of MEC or MC. The RFI will accomplish the following objectives:

- Determine nature and extent of MEC.
- MC is not a concern because its presence was not confirmed in the CS and there are no known sources. However, if potential sources are encountered during MEC investigation (i.e., exposed fillers, burial pits containing DMM, or small arms berms), assess presence of MC and delineate extent.
- Determine the hazard and risk posed to human health and the environment by MEC and MC.
- Collect or develop additional data for the CMS, as appropriate, to determine corrective measure alternatives for mitigation, including no action.

It should be noted that although the Phase 2 CS did not recommend further investigation of MC, it was agreed upon by the project team (including FTSW, U.S. Army Environmental Command [USAEC], and USACE) that MC will be investigated if MEC such as breached munitions or munitions caches are identified during investigations.

2.2 PROJECT ORGANIZATION

Figure 2-1 presents the project organizational chart for the FTSW RFI. Safety responsibilities, accountability, and lines of authority are discussed in the APP (CB&I, 2014). The CB&I Project Manager (PM), Field Team Leader, Senior Unexploded Ordnance Supervisor (SUXOS), Unexploded Ordnance Safety Officer (UXOSO), and the Health and Safety Manager (HSM) are responsible for formulating and enforcing health and safety requirements and implementing the Site Safety and Health Plan (SSHP), which is part of the APP.

2.3 PROJECT PERSONNEL

The following personnel have been assigned to this project and will guide the work to its completion:

- PM—Alex Smith, PMP, PG
- MMRP Technical Lead—Emily Tucker
- SUXOS—David Coe
- UXOSO—Bill Dickson
- Unexploded Ordnance Quality Control Specialist (UXOQCS)—Bill Dickson
- Project Geophysicist—Jeremy Flemmer
- Project Chemist—Randy McBride

The resumes of these personnel are provided in **Appendix F**. The roles and responsibilities for each are described below.

2.3.1 Project Manager

The PM will be responsible for overall project management and will be the primary point of contact to USACE. The PM will manage and integrate team members, oversee the preparation of reports, and oversee cost and schedule control.

2.3.2 MMRP Technical Lead

The MMRP Technical Lead assists the PM in developing and executing the technical approach for addressing MMRP sites. The MMRP Technical Lead is the central point of contact for all other technical personnel, ensuring proper data flow, compliance and consistency of engineering and technical project execution, and review of data and reports for quality, accuracy, and completeness.

2.3.3 Senior UXO Supervisor

The SUXOS will directly control the operations of field personnel performing MEC activities and may assist them in achieving maximum operational safety and efficiency. The SUXOS will work directly with the Unexploded Ordnance (UXO) Teams and the MMRP Technical Lead, and when appropriate, will consult with the USACE Safety Specialist concerning technical MEC issues. The SUXOS will implement the approved plans in the field and will review and approve any changes to the approved UXO plans. The SUXOS will have final authority in decision situations regarding all MEC issues and the performance of disposal activities.

2.3.4 UXO Safety Officer

The UXOSO will conduct training of project personnel and accompany them during on-site RFI activities. The UXOSO will be responsible for MEC safety and will ensure that the SSHP is fully implemented at FTSW. The UXOSO has the authority to stop work should a serious situation arise.

2.3.5 UXO QC Specialist

The UXOQCS will perform all on-site quality control (QC) activities, develop Daily QC Reports (DQCRs) and implement the QCP as discussed in Section 4.0.

2.3.6 Project Geophysicist

The Project Geophysicist has overall responsibility for design, implementation, and management of all geophysical investigations. The Project Geophysicist will establish and approve technical procedures, conduct technical QC procedures on the data, communicate with the geophysical crew to guide the progress of the investigation and ensure that the objectives are being met, and approve the geophysical sections of the RFI report.

2.3.7 Project Chemist

The Project Chemist is directly responsible for providing oversight in developing and implementing the project UFP-QAPP, specifying appropriate analytical methods, laboratory and field QC and quality assurance, analytical data reporting, management, review, validation, and analysis, as applicable. The Project Chemist will be responsible for chemical QC whenever sampling or analysis for chemical constituents is required. The Project Chemist will ensure laboratory services are to be performed only by laboratories compliant with the most recently published DoD Quality Systems Manual (QSM) and holding a current National Environmental Laboratory Accreditation Conference accreditation for all appropriate fields of testing.

2.4 PROJECT COMMUNICATIONS AND REPORTING

All communication to stakeholders and regulators will be coordinated with USACE and FTSW Directorate of Public Works (DPW). CB&I will keep a record of phone conversations and written correspondence affecting decisions relating to the performance of this RFI. CB&I will prepare and submit minutes of all significant meetings attended. Status reports will be submitted according to Section 2.7.

2.5 PROJECT DELIVERABLES

Project deliverables will consist of the following documents:

- RFI Work Plan
- RFI Report

Deliverables will be produced in draft for Army review, draft-final for regulatory review, and final versions. Deliverables will be provided in both hard copy and electronic (PDF) format in a sufficient number of copies as requested by the various project stakeholders.

2.6 PROJECT SCHEDULE

An overall project schedule is provided as **Figure 2-2**. Mobilization for field work is anticipated to occur in June 2015. The duration of the field effort is expected to be approximately 3 months.

2.7 PERIODIC REPORTING

CB&I will provide monthly progress reports as part of the overall FTSW project as defined in the Project Management Plan (PMP).

When in the field, CB&I will prepare DQCRs that will serve to document project status. CB&I will also prepare and submit weekly status reports during field activities to document field activities completed and planned. The report will be delivered electronically via e-mail or posted to a project website.

2.8 COSTING AND BILLING

CB&I will submit invoices based on milestones completed as discussed in the PMP.

2.9 PROJECT PUBLIC RELATIONS SUPPORT

CB&I will not make available or publicly disclose any project data or reports generated or reviewed under this contract unless specifically authorized by USACE. CB&I will assist FTSW in managing public affairs related to all MMRP RFI activities. The support will be determined and may include preparation of a community relations plan, public meetings, fact sheets, etc.

2.10 SUBCONTRACTOR MANAGEMENT

Subcontractors may include land surveyors and potentially UXO Technicians. Each subcontractor working on the project site will be required to adhere to the APP/SSHP and will be subject to the same training and medical surveillance requirements as CB&I personnel depending on job activity.

2.11 MANAGEMENT OF FIELD OPERATIONS

Overall project management will be coordinated within the CB&I Belcamp office. Field operations will be managed by the SUXOS at FTSW. Field teams may be composed of CB&I staff from throughout the United States (e.g., UXO Technicians). Such resources, as well as any necessary subcontractor support, will be managed by the PM. The UXOSO/UXOQCS will be responsible for confirming that proposed project personnel have the necessary experience and required training for the project.

3.0 FIELD INVESTIGATION PLAN

3.1 OVERALL APPROACH TO MUNITIONS RESPONSE ACTIVITIES

The primary objective of the RFI field investigation is to determine the nature and extent of MEC and presence/absence of MC. The overall approach is as follows:

- Assess MEC
  - Conduct surface reconnaissance to assess MEC/MDAS at each MRS. Although formal visual survey transects are not proposed, the presence of surface MEC/MDAS will be investigated during the geophysical investigation.
  - Conduct an analog geophysical survey and subsurface anomaly investigations on a representative portion of the MRS to evaluate subsurface MEC/MDAS at the MRS.
  - Conduct a digital geophysical mapping (DGM) survey and subsurface investigations to evaluate subsurface discarded military munitions (DMM) around the firing points.
- Assess MC
  - MC is not a concern because its presence was not confirmed in the CS and there are no known sources. However, if potential sources are encountered during MEC investigation (i.e., exposed fillers, burial pits containing DMM, or small arms berms), the presence of MC will be assessed and delineated.

A more detailed discussion of this approach, including the areas to sample, is provided below in Section 3.2.

3.1.1 Site Characterization Goals

The primary MRS characterization goals are to collect sufficient data to:

- Determine the nature and extent of MEC, including:
  - Types
  - Location
  - Depth
  - Density
- Determine the presence/absence MC, including:
  - Specific chemicals of concern (COCs)
  - Distribution and concentrations by media
- Determine the hazard/risk posed to human health and the environment by MEC and MC
- Collect or develop additional data for the CMS, as appropriate, to determine corrective measure alternatives

3.1.2 Data Incorporation into the RFI

Whenever possible, existing data will be incorporated into the RFI. The following is a summary of existing data and how it will be used:

- <u>Historical Records Review</u>—The HRR provides historical documentation regarding the sites and identifies the types of activities conducted, the types of munitions used, and historical finds and incidents. These data are used to identify the expected baseline conditions, to assess risk, and to identify the Munition with the Greatest Fragmentation Distance (MGFD) and other hazards that may be present.

- CENAB and TCRA Data—The CENAB and TCRA investigations provide surface and subsurface findings during the investigations at the Anti-Aircraft Range - 4A. This data will be incorporated into the RFI and used to assess the MEC hazards at the MRS.
- Phase 2 CS Data—Since no further MC sampling is planned, this data will not be used in the RFI. However, if a potential MC source is found and media sampled, and an MC release is confirmed to be present and delineated for the RFI, then the CS data set will be merged with RFI sampling data and used in the risk assessment if the data are found to be suitable. The suitability of the data to be used in the risk assessment is addressed in Worksheet #11 of the UFP-QAPP.

3.1.3 MEC Exposure Analysis

MEC exposure analysis compiles all known information into an illustration of exposure pathways. The Ordnance and Explosives (OE) Conceptual Site Model (CSM) document (USACE, 2003) divides the analysis into four components: source, activity, access, and receptor. Each component is briefly discussed in the following sections.

3.1.3.1 Source

A MEC source area is the location where UXO or other forms of ordnance are expected to be found. A preliminary assessment of potential MEC source areas is provided by the HRR, CENAB investigations, TCRAs, and Phase 2 CS.

Anti-Aircraft Range - 4A and 4B

The Anti-Aircraft Range - 4A consists of 465 acres where MEC investigations and removals were performed by CENAB. The Anti-Aircraft Range - 4B represents the 663 acres that remain undeveloped and largely uninvestigated.

The Anti-Aircraft Range - 4A and 4B together represent the firing points and vicinity for three overlapping 40mm and 90mm anti-aircraft ranges that fired to the north, extending well beyond the MRSs into the Operational Range of FTSW. Activities associated with the anti-aircraft range training took place from 1941 to 1964. During range activities, M2 target rockets served as aerial targets for anti-aircraft gunners. The M2 target rocket, which simulated low-flying high-speed aircraft, was fired from a mobile launcher with a solid propellant. These rockets did not contain explosives and had a maximum range of approximately 1 mile. In addition to range activities, troops may have also buried DMM (M2 target rockets, 90mm projectiles, and 40mm projectiles) close to the firing points during training exercises.

In 2011, several MEC investigations/removal actions were performed within the Anti-Aircraft Range - 4A. During these investigations, mag and dig activities were performed within the MRS. Munitions items found include: numerous M2 target rockets, occasional 40mm and 90mm projectiles which are associated with site use, as well as, isolated finds of munitions not associated with the reported range history (2.75-inch rockets, 3.5-inch rockets, 81mm practice mortars, and M67 hand grenades).

With no evidence of stationary land-based targets in the site history or previous investigation, overall homogenous UXO distribution is anticipated in the surface and subsurface. This UXO is expected to consist of 40mm and 90mm projectiles that fell short of their targets. Additionally, there may be 40mm or 90mm projectiles buried as DMM in the subsurface near the firing points.

Anti-Aircraft Range - 4A is developed and has had a high percentage of the MRS investigated for MEC by CENAB, with a resulting determination of a low probability for future exposure to MEC. Anti-Aircraft Range - 4B is undeveloped and largely uninvestigated. The distribution and density of MEC is not anticipated to be different than Anti-Aircraft Range - 4A.

Anti-Tank Range 90-MM-2

The Anti-Tank Range 90-MM-2 is a 546-acre MRS. The eastern portion of the MRS was historically used for firing 40mm anti-aircraft and 90mm anti-tank rounds from what is now covered with a motor pool and fueling station. These range fans extended well beyond the MRS into the Operational Range of FTSW. The western portion of the MRS partially overlaps small arms, grenade launcher, and 120mm anti-aircraft range fans that fired from slightly south of the MRS. The large areal extent and layout of the range fans and the relatively small size of the MRS near the firing points suggest that target areas associated with 40mm, 90mm, and 120mm projectiles are not anticipated. Troops may have also buried DMM (40mm anti-aircraft and 90mm anti-tank rounds) close to the firing points during training exercises.

During the Phase 2 CS, one MDAS item, an M16A1 anti-personnel mine was observed. Due to the extensive use of FTSW, stray munitions, such as the M16A1 anti-personnel mine, not associated with the site history are occasionally observed. With no evidence of stationary land-based targets in the site history or previous investigation, overall homogenous UXO distribution is anticipated in the surface and subsurface. This UXO is expected to consist of 40mm Anti-Aircraft, 90mm Anti-Tank rounds, and potentially 120mm projectiles that fell short of their targets. Additionally, there may be 40mm or 90mm projectiles buried as DMM in the subsurface near the firing points.

Grenade Launcher Range

The Grenade Launcher Range MRS was used for anti-aircraft, anti-tank, grenade launcher, and small arms training during the 1940s. Three small arms ranges (H, B, and A) are located within the MRS, which consisted of numerous firing mounds. Range B was also used to fire 40mm practice grenades with grenade launchers. A 9.2-acre infiltration course is located within Range H, which included .30-cal machine gun firing and detonations of one pound blocks of TNT to simulate battle conditions. A firing point for 120mm anti-aircraft projectiles was also located on the western portion of the MRS. Due to the use of 40mm grenades, the Grenade Launcher Range fan and area around the target berms have the potential to contain UXO on the surface or in the subsurface. The remainder of the MRS, including the Infiltration Course, was used for small arms training. As such, UXO is not anticipated in those areas. DMM (120mm anti-aircraft projectiles) may be present, if buried, in/around the 120mm firing point.

During the Phase 2 CS, pop flares (expended), empty ammo cans, and expended small arms cartridges were observed.

3.1.3.2 Activity

The hazard from MEC arises from direct contact as a result of some human activity. This human activity could be moving or somehow disturbing MEC that could cause it to detonate. This could occur during construction activities as well as maintenance and training activities at the installation. Receptors in the area could all deliberately or inadvertently disturb MEC. The current and future land use of the FTSW MRSs is presented in Section 1.7.

3.1.3.3 Access

FTSW is readily accessible via multiple roads. Once access to FTSW property has been obtained, there are no further restrictions to access any of the MRSs with the possible exception of the gate to enter Anti-Aircraft Range - 4A.

3.1.3.4 Receptors

Receptors at FTSW include residents, authorized installation personnel (including construction workers, maintenance workers, and trainees), visitors, and trespassers at all MRSs. A gate limits access for residents, visitors, and trespassers to Anti-Aircraft Range - 4A. In addition, wildlife could be affected including rare, threatened, or endangered species.

3.1.4 Use of Time Critical Removal Actions During the Munitions Response Project

Use of TCRAs is not anticipated during the RFI. If there is a need for a removal action (RA), the requirements detailed in Section 4-5 of Engineer Regulation (ER) 200-3-1 (USACE, 2004) and in the NCP will be followed. The need for an RA would be based on the evaluation of site-specific features:

- The nature of the MEC or the presence of MC contamination
- The urgency/threat of release or potential release of MEC or MC contamination
- The timeframe required for initiating an RA

Based on the evaluation of these features at the FTSW MRSs, an emergency, time critical, or non-time critical RA could be selected.

3.1.5 Follow-On Activities

There are no specific follow-on investigation activities currently planned. Once all RFI data are collected, an RFI Report will be prepared by CB&I, identifying the nature and extent of contamination and potential risks to human health and the environment. For MRSs where there is a risk that must be addressed, a CMS will be prepared to develop and evaluate potential corrective measures to address these risks. The proposed action will then be presented to the public in a Statement of Basis. After public comments are received, the RCRA Permit will be modified to include the selected remedy. A Corrective Measures Implementation will be developed and performed, which may consist of institutional controls and/or any other appropriate response action.

3.1.6 Data Quality Objectives

Data quality objectives (DQOs) were developed for MEC in accordance with the *Data Quality Objectives Process for Hazardous Waste Site Investigations*, EPA QA/G-4HW (USEPA, 2000). In developing the DQOs at the FTSW MRSs, CB&I followed the following DQO process:

1. State the Problem
2. Identify the Decision
3. Identify inputs to the Decision
4. Define the Study Boundaries
5. Develop a Decision Rule
6. Specify Limits on Decision Error
7. Optimize the Design for Obtaining Data

Table 3-1 through **Table 3-4** identify the DQO process for the MRSs addressed in this work plan. The DQOs proposed for geophysical investigations are identified in Section 3.3. The DQOs for MC sampling are presented in Worksheet #11 of the project UFP-QAPP (**Appendix H**).

Table 3-1
MEC DQO Process at the Anti-Aircraft Range - 4A

Step	Data Quality Objective
1. State the problem	There is the potential for MEC in the subsurface as UXO (items that were fired on the range), although CENAB investigations determined this probability to be low (MEC QA Follow-On Investigation 2011). A significant amount of data are available for this MRS to describe the nature and extent of MEC. In searching approximately 200 of the 465 acres, two MEC items were found. The firing points are not located within Anti-Aircraft Range - 4A (they are within Anti-Aircraft Range - 4B).
2. Identify the decision	The information evaluated during the RFI will be used to assess the MEC hazards posed to human health and the environment and determine whether further action is needed.
3. Identify inputs to decision	• Historical Information • Previous Investigations • Evaluation of potential hazards associated with MEC to human health using MEC Hazard Assessment (HA)
4. Define study boundaries	The Anti-Aircraft Range - 4A consists of 465 acres where MEC investigations and removals were performed by CENAB. The MRS is bounded by the operational range to the north. The MRS boundary is as defined in the Phase 2 CS.
5. Develop a decision rule	If there is an area where an increased density of MEC/MD is evident, consider the area a Concentrated Munitions Use Area (CMUA) and determine the boundary based on a thorough analysis of historical and current aerial photography and previous investigations. If there are no CMUAs (as anticipated for the Anti-Aircraft Range - 4A based on previous investigations and because rounds fired on the range would have landed outside the MRS), then run UXO Estimator software “Analyze Field Data” module to determine whether adequate coverage was obtained at the MRS. If adequate coverage was obtained (as anticipated because 200 of 465 acres has been searched for MEC), then no further data are needed. If MEC hazards are identified, then proceed to CMS.
6. Specify limits on decisions	UXO Estimator will be used to statistically analyze previously collected data with a 95% confidence limit and a target UXO density of 0.5 UXO/acre.
7. Optimize design for obtaining data	For the Anti-Aircraft Range - 4A, there are no known CMUAs or firing points. UXO Estimator software “Analyze Field Data” module was run to determine whether adequate coverage was obtained at the MRS, using the following inputs: 465-acre MRS, 200 acres investigated, two UXO found, 0.5 UXO/acre target density, and 95% confidence level. UXO Estimator calculated with 95% probability that there is less than 0.026 UXO per acre in the MRS. We can be 95% confident that there are less than 12 UXO in the 465-acre MRS. Since two were already found, we are 95% confident that that there are less than 10 UXO in the remaining 265 acres that were unsearched. Based on this analysis, sufficient coverage was obtained to characterize the MRS and no additional field investigation is warranted. The RFI will include a MEC HA and will determine whether corrective measures should be evaluated in a CMS.

Table 3-2
MEC DQO Process at the Anti-Aircraft Range - 4B

Step	Data Quality Objective
1. State the problem	There is the potential for MEC on the surface or in the subsurface as UXO (items that were fired on the range) or DMM (items that were intentionally buried near the firing points).
2. Identify the decision	The information obtained during the RFI will be used to assess the MEC hazards posed to human health and determine whether further action is needed.
3. Identify inputs to decision	• Historical Information • Previous Investigations • Geophysical Investigation using analog geophysics (mag and dig) or DGM (EM61-MK2) • Intrusive Investigation of anomalies • Evaluation of potential hazards associated with MEC to human health
4. Define study boundaries	The Anti-Aircraft Range - 4B represents the 663 acres that remain largely undeveloped and uninvestigated. The MRSs are bounded by the operational range to the north. The RFI will be performed in the MRS boundaries as defined from the Phase 2 CS.
5. Develop a decision rule	If there is an area where an increased density of MEC/MD is evident, consider the area a CMUA and determine the boundary based on a thorough analysis of historical and current aerial photography, previous investigations, and transect/geophysical data. If CMUAs are not encountered (as anticipated for the Anti-Aircraft Range 4B because rounds fired on the range would have landed beyond the MRS in the operational ranges), then use UXO Estimator to determine sampling acreage and investigate all anomalies. If there are firing points, then collect DGM data from the firing point locations and excavate anomalies that have the potential to represent pits of buried DMM. If MEC is found, then determine the nature and extent of MEC in the area and perform a MEC HA at the MRS. If MEC hazards are identified, then proceed to CMS.
6. Specify limits on decisions	UXO Estimator will be used to statistically determine sampling area with a 95% confidence limit and a target UXO density of 0.5 UXO/acre. Geophysicists will select anomalies at firing points that represent potential DMM burial pits. Anomalies greater than 3 feet across will be the primary selection criteria. All potential pits will be evaluated. In the case where a large number of potential pits are identified, a statistical percentage of these will be investigated using the Visual Sample Plan (VSP) module.
7. Optimize design for obtaining data	For the Anti-Aircraft Range - 4B, a minimum of 5.95 acres will be investigated based on the following UXO Estimator inputs: 663 acre MRS, 0.5 UXO/acre target density, and 95% confidence level. The data will consist of analog geophysical transects distributed throughout the MRS. In areas where transects are less feasible due to buildings and roads, DGM grids will be utilized. All anomalies will be investigated. Additionally, approximately 4.6 acres of DGM is proposed to identify potential DMM burial pits. Locations that have the potential to contain pits of buried DMM will be investigated.

Table 3-3
MEC DQO Process at the Anti-Tank Range 90-MM-2

Step	Data Quality Objective
1. State the problem	There is the potential for MEC on the surface or in the subsurface as UXO (items that were fired on the range) or DMM (items that were intentionally buried near the firing points).
2. Identify the decision	The information obtained during the RFI will be used to assess the MEC hazards posed to human health and determine whether further action is needed.
3. Identify inputs to decision	• Historical Information • Previous Investigations • Geophysical Investigation using analog geophysics (mag and dig) or DGM (EM61-MK2) • Intrusive Investigation of anomalies • Evaluation of potential risk associated with MEC to human health
4. Define study boundaries	The Anti-Tank Range 90-MM-2 is a 546-acre MRS. The MRS is bound by the operational range to the north. The Anti-Tank Range 90-MM MRS, which contains the active landfill, is not part of the MRS. The RFI will be performed in the MRS boundaries as defined from the Phase 2 CS.
5. Develop a decision rule	If there is an area where an increased density of MEC/MD is evident, consider the area a CMUA and determine the boundary based on a thorough analysis of historical and current aerial photography, previous investigations, and transect data. If CMUAs are not encountered, (as anticipated for the Anti-Tank Range 90-MM-2 because rounds fired on the range would have landed beyond the MRS in the operational ranges), then use UXO Estimator to calculate sampling acreage and investigate all anomalies. If there are firing points, then collect DGM data from the firing point locations and excavate anomalies that have the potential to represent pits of buried DMM. If MEC is found, then determine the nature and extent of MEC in the area and perform a MEC HA at the MRS. If MEC hazards are identified, then proceed to CMS.
6. Specify limits on decisions	UXO Estimator will be used to statistically determine sampling area with a 95% confidence limit and a target UXO density of 0.5 UXO/acre. Geophysicists will select anomalies at firing points that represent potential DMM burial pits. Anomalies greater than 3 feet across will be the primary selection criteria. All potential pits will be evaluated. In the case where a large number of potential pits are identified, a statistical percentage of these will be investigated using the VSP module.
7. Optimize design for obtaining data	At the Anti-Tank Range 90-MM-2, a minimum of 5.94 acres will be investigated based on the following UXO Estimator inputs: 546-acre MRS, 0.5 UXO/acre target density, and 95% confidence level. Analog geophysical transects will be placed throughout the MRS and all anomalies will be investigated. Additionally, approximately 2.3 acres of DGM is proposed to identify potential DMM burial pits. Locations that have the potential to contain pits of buried DMM will be investigated.

Table 3-4
MEC DQO Process at the Grenade Launcher Range

Step	Data Quality Objective
1. State the problem	The Grenade Launcher Range fan and area around the target berms have the potential to contain UXO on the surface or in the subsurface in the form of 40mm grenades. Burial pits near the 120mm firing point, if present, have the potential to contain DMM in the subsurface. The remainder of the MRS, including the Infiltration Course, was used for small arms training. As such, MEC is not anticipated in those areas.
2. Identify the decision	The information obtained during the RFI will be used to assess the MEC hazards posed to human health and the environment and determine whether further action is needed.
3. Identify inputs to decision	• Historical Information • Previous Investigations • Geophysical Investigation using analog geophysics (mag and dig) or DGM (EM61-MK2) • Intrusive Investigation of anomalies • Evaluation of potential risk associated with MEC to human health and the environment
4. Define study boundaries	The Grenade Launcher Range is a 143-acre MRS. The MRS is bound by the operational range to the north. The RFI will be performed in the MRS boundaries as defined from the Phase 2 CS.
5. Develop a decision rule	If CMUAs are expected (as anticipated since grenades were fired at the berm within the MRS), then use the VSP "Transect Sampling for UXO Target Traversal" module to develop the sampling plan for this portion of the MRS. If there are firing points, then collect DGM data from the firing point locations and excavate anomalies that have the potential to represent pits of buried DMM. If MEC is found, then determine the nature and extent of MEC in the area and perform a MEC HA at the MRS. If MEC hazards are identified, then proceed to CMS.
6. Specify limits on decisions	VSP "Transect Sampling for UXO Target Traversal" module with 10 meter diameter target. Geophysicists will select anomalies at firing points that represent potential DMM burial pits. Anomalies greater than 3 feet across will be the primary selection criteria. All potential pits will be evaluated. In the case where a large number of potential pits are identified, a statistical percentage of these will be investigated using the VSP module.
7. Optimize design for obtaining data	At the Grenade Launcher Range, analog geophysical transects are proposed around the grenade launcher target berm on 10-meter spacing (2.53 acres total) based on VSP. All anomalies will be investigated. In addition, approximately 1 acre of DGM is proposed to identify potential DMM burial pits. Locations that have the potential to contained pits of buried DMM will be investigated.

3.2 INVESTIGATION STRATEGY

The MRSs selected for investigation as part of the RFI include the Anti-Aircraft Range - 4A (465 acres), Anti-Aircraft Range - 4B (663 acres), Anti-Tank Range 90-MM-2 (546 acres), and the Grenade Launcher Range (143 acres). A combination of visual surveys, analog geophysical surveys, DGM surveys, and intrusive investigations will be performed to determine the locations, depths, density, and condition of MEC and/or MDAS.

Media sampling and analysis will be performed to determine levels of MC contamination as described in detail in the UFP-QAPP (**Appendix H**). The types of media to be sampled, locations and number of samples, methods of sampling, and analyses to be performed will be determined in conjunction with the USACE and GAEPD based on the results of the MEC investigation. The analytical methods selected to address chemical contaminants will be based on the types of items known or suspected to exist at each MRS. Other analyses may be added based on the MEC findings and input from the USACE and GAEPD. The approach is specified in the UFP-QAPP, which was prepared in accordance with DoD QSM, Version 5.0 (DoD, 2013) and Uniform Federal Policy for Quality Assurance Project Plans (DoD, 2012b). The UFP-QAPP is comprehensive and includes discussion of problem definition and data use, quality objectives and planning process statements, measurement performance criteria, sampling design and rationale, sampling locations and methods, QC sampling, analytical methods, and sample handling and custody.

3.2.1 MEC Investigation Strategy

The first task of the RFI is to characterize the nature and extent of MEC as well as MDAS and other former range features. For the Anti-Aircraft Range - 4B, Anti-Tank Range 90-MM-2, and Grenade Launcher Range, this will be performed initially with an analog geophysical survey over a portion of the MRS to assess MEC/MDAS on the surface and subsurface, followed by a DGM survey and intrusive investigation of the firing points to assess the presence of burial pits containing DMM.

The strategy for each MRS is summarized as follows and explained further in the following paragraphs.

MRS	MEC Investigation Strategy
Anti-Aircraft Range - 4A	• Utilize existing dataset
Anti-Aircraft Range - 4B	• Surface reconnaissance in the southeast lobe where a hand grenade was observed • Surface/subsurface Investigation via analog geophysical transects and DGM mini-grids guided by UXO Estimator • DGM survey and intrusive investigation of firing points
Anti-Tank Range 90-MM-2	• Surface/subsurface Investigation via analog geophysical transects guided by UXO Estimator • DGM survey and intrusive investigation of firing points
Grenade Launcher Range	• Surface/subsurface Investigation via analog geophysical transects around grenade launcher target berm guided by VSP • DGM survey and intrusive investigation of 120mm range firing point

At the Anti-Aircraft Range - 4A, MEC investigations and RAs have been performed. CB&I will use the existing dataset to characterize the MRS. Since no target areas were found within the MRS, it is assumed that the Anti-Aircraft Range - 4A has a homogenous, random distribution of MEC. As such, UXO Estimator was selected as the appropriate tool to develop the sampling plan for this MRS. The UXO Estimator software “Analyze Field Data” module was run to determine whether sufficient coverage was obtained for the Anti-Aircraft Range - 4A MRS. Based on review of previous CENAB investigations and RAs, CB&I estimates that approximately 200 acres (or 43 percent) of the MRS was previously searched for MEC. During these investigations and RAs, two MEC items were found. UXO Estimator calculated with 95 percent probability that there is less than 0.026 UXO per acre in the MRS, which is below the target density of 0.5. Based on this analysis, no additional field investigation is warranted.

3.2.1.1 Surface Reconnaissance

During a previous investigation, an M67 hand grenade was found in the southeastern portion of the Anti-Aircraft Range - 4B. The history of the MRS does not suggest the presence of a hand grenade range. In order to confirm that additional hand grenades are not present in the immediate area, CB&I will perform a surface reconnaissance in the southeastern portion of the MRS. **Figure 3-1** presents the location of the proposed surface reconnaissance. The surface reconnaissance will be performed by a 6-person team of CB&I UXO Technicians using Schonstedt magnetometers and traversing the MRS on foot spaced from 10 feet apart. The location and description of all MEC/MDAS items and range features (if present) will be logged by Global Positioning System (GPS). The intent is not to locate and identify every metallic anomaly on the surface, but to investigate metallic items on the surface and gain an understanding of what types of activities occurred. Since hand grenades do not penetrate into the ground, an investigation of metallic items on the surface is sufficient to find grenades or evidence of grenade usage (fragments and pins). The data collected will be reviewed by the team and provided to the Army and regulators during weekly reports.

3.2.1.2 Analog Geophysical Survey

An analog geophysical investigation will be performed in order to evaluate subsurface MEC/MDAS at the MRS. This will be conducted using handheld, analog instruments in mag and dig fashion in accordance with Section 3.2.2. The presence of surface MEC/MDAS will also be investigated during the geophysical investigation.

Anti-Aircraft Range - 4B and Anti-Tank Range 90-MM-2

The Anti-Aircraft Range - 4B and Anti-Tank Range 90-MM-2 contain firing points of range fans. The targets associated with the Anti-Aircraft ranges were aerial and the targets associated with the anti-tank range were located within the landfill. The majority of projectiles fired from these MRSs are expected to have landed in operational areas or the land underneath the landfill. Since no target areas are anticipated within the MRSs, it is assumed that the Anti-Aircraft Range - 4B and Anti-Tank Range 90-MM-2 MRSs have a homogenous, random distribution of MEC. Based on this assessment, UXO Estimator Version 2.2 is the appropriate tool to develop the sampling plan for these MRSs. The input values used include an upper confidence level of 95 percent and a target density of 0.5 UXO per acre representative of sites where public usage of the area is moderate (e.g., a hiking or hunting area or large subdivision). Using this program, the minimum sampling amounts are as follows:

MRS	MRS Size (acres)	Area to Sample (acres)
Anti-Aircraft Range - 4B	663	5.947
Anti-Tank Range 90-MM-2	546	5.938

The data will be collected using primarily transects to provide thorough wide area assessment. In developed areas where buildings and roads disrupt continuous transects, DGM mini-grids are preferred and make evacuations more manageable.

At the Anti-Aircraft Range - 4B, approximately 12 miles of analog geophysics transects (325-foot spacing as shown on **Figure 3-2**) will be collected to assess the MRS for individual 40mm and 90mm projectiles that may be present as UXO. Additional grid surveying will also be performed in developed areas of the Anti-Aircraft Range 4B, as discussed in Section 3.2.2.

At the Anti-Tank Range 90-MM-2, 12.6 miles of analog geophysical transects (272-foot spacing as shown on **Figure 3-3**) will be collected. Assuming a 4-foot transect width, this will yield 6.1 acres of data.

Each transect is proposed as a straight line, although the field team may deviate as needed to negotiate terrain conditions. Transects will consist of one long line of analog geophysical data where the UXO Technician sweeps the magnetometer back and forth 2 feet on either side of their body giving the transect a width of 4 feet. Each transect is proposed as a straight line, although the field team may deviate as needed to negotiate terrain conditions. Transects will consist of one long line of analog geophysical data where the UXO Technician sweeps the magnetometer back and forth 2 feet on either side of their body, giving the transect a width of 4 feet. All metallic anomalies identified on transects will be excavated in accordance with Section 3.5 to identify the nature of the metallic item.

Proposed transects may also be adjusted to avoid sensitive areas such as inaccessible wetlands, as long as reasonably complete coverage of the MRS is achieved. CB&I will work closely with FTSW environmental office when working in or near wetlands.

Grenade Launcher Range

The Grenade Launcher Range MRS, which is 143 acres, was used as a small arms range (Ranges H, B, and A), 40mm practice grenade range (Range B), infiltration course, and a firing point for a 120mm projectile range. Within the MRS, MEC may be present at Range B (40mm projectiles) and at the 120mm firing point (in the form of DMM).

The majority of Range B, which was used as a grenade launcher range, was developed and is now covered by roads, buildings, and concrete. No investigation is planned for this area because 1) there were no reported finds of munitions during construction, 2) the roads, buildings and concrete affect geophysical surveys, and 3) the roads, buildings, and concrete limits the potential for exposure to MEC if present in the subsurface. However, the target berms, which have the potential to be a CMUA and are the main location for UXO to be found, if present, are located within the forested area of the MRS and can readily be investigated. The VSP "Transect Sampling for UXO Target Traversal" module is the appropriate tool to develop the sampling plan for this portion of the MRS. Based on Field Manual 3-22.31, *40mm Grenade Launcher, M203* (Army, 2003), the anticipated target size for a typical 40mm Firing Range ranges from 2 to 10 meters. In order to ensure the footprint of the target area is traversed, CB&I will collect data around the target berms at 10-meter transect spacing. **Figure 3-4** presents the analog geophysical approach at the Grenade Launcher Range

3.2.2 DGM Survey and Intrusive Investigation

In order to assess the potential for buried DMM, a DGM survey and intrusive investigation is proposed near the firing points of each range. The DGM survey will be conducted using an EM61-MK2 in accordance with Section 3.3.

CB&I reviewed historical aerial photographs and identified disturbed areas in/around the firing points. These were identified as areas that have the potential to contain buried DMM. Approximate historical firing points boundaries are outlined on **Figures 3-5** through **Figure 3-7**. The goal of the investigation is to assess the potential for buried DMM, not to identify every area that could contain buried DMM. As such, a representative portion of large geophysical anomalies will be investigated. Based on this analysis, the following DGM coverage is proposed:

MRS	Disturbed Area (acres)	Area to Survey (acres)
Anti-Aircraft Range - 4B	83.63	4.6
Anti-Tank Range 90-MM-2	35.7	2.3
Grenade Launcher Range	7.35	1.0

At the Anti-Aircraft Range - 4B, CB&I will perform DGM surveys at five 200 x 200-foot grids as shown on **Figure 3-5**. Grids were selected in the Anti-Aircraft Range - 4B since the areas are open (no vegetative clearance required) and can be surveyed with minimal interference from cultural features such as roads, buildings, and utilities. This will provide a clearer picture of burial pits compared to single lines of transect data.

At the Anti-Tank Range 90-MM-2, 5.8 miles of DGM transects (50-foot spacing) will be collected as shown on **Figure 3-6**. Transects provide good wide area assessment and can be surveyed with only limited vegetation removal by going around trees. The orientation of transects may be adjusted from that shown on **Figure 3-6** to run either perpendicular to or parallel to roads.

At the Grenade Launcher Range, 2.4 miles of transects (25-foot spacing) will be collected as shown on **Figure 3-7**. Again, transects were selected because they provide better wide area assessment compared to grids and can be surveyed with only limited vegetation removal by going around trees.

3.2.3 MC Characterization

Environmental samples were collected during the Phase 2 CS, which concluded that there are no significant environmental impacts from MC at the MRSs included in this work plan.

Pre-planned sampling is not currently included in this effort. However, the need for additional sampling may be identified during the course of the RFI, if evidence of potential releases is identified during the field investigation. If evidence of exposed fillers, burial pits containing DMM, or small arms berms (not previously sampled) are observed during the RFI field activities, additional sampling may be required. Details on the MC approach and DQO process are provided in the UFP-QAPP (**Appendix H**).

3.3 GEOPHYSICAL INVESTIGATION PLAN

This section was developed in accordance with the DID MMRP-09-004, Engineer Manual (EM) 200-1-15, and Digital Geophysical Mapping Guidance Operational Procedures and Quality Control Manual (DGM QC Guidance) (USAESCH, 2003). Analog magnetometers will be used for the one dimensional (1D) transects. EM61-MK2 geophysical sensors will be used for two dimensional (2D) “full coverage” grid DGM surveys in conjunction with real-time kinematic (RTK) GPS, robotic total station (RTS), or fiducial positioning systems. The use of Schonstedts (or equivalent) to perform the surface sweeps and mag and dig operations is anticipated. The areas for the proposed geophysical surveys for the applicable MRSs in this work plan are shown on **Figure 3-2** through **Figure 3-7**.

3.3.1 Site Description and Conditions

The following subsections describe site-specific conditions that pertain to DGM investigations.

3.3.1.1 Anticipated MEC Types

The following anticipated munition types are considered primary targets for this investigation based on the historical usage (Malcolm Pirnie, Inc., 2010) at the MRSs:

- M2 Target Rockets (not explosively configured)
- 40mm projectiles
- 90mm projectiles
- 120mm projectiles
- 40mm grenades

Additionally, there have been isolated munitions found at MRSs including: 2.75” rockets, 3.5” rockets, 81mm practice mortars, M67 hand grenades, and M16A1 anti-personnel mine. These munitions types are not anticipated based on site use, and are not used to drive geophysical investigations. All of these items are ferrous, and therefore can be detected with either magnetometer or EM instrumentation.

3.3.1.2 Depth Anticipated

The anticipated depth for most of the MEC items of interest is anticipated to be from the surface to approximately 2 feet below ground surface (bgs). The Phase II HRR provided estimated maximum penetration depths for the various munitions of concern. In the sandy soils of FTSW, these depths are 0.2 feet for 40mm projectiles, 2.0 feet for 90mm projectiles, and 9 feet for 120mm projectiles (HRR). Although the estimated maximum penetration depth for the 120mm projectile is greater than 2 feet, it should be noted that maximum estimated penetration depths are based on a worst-case scenario, which assumes three conservative conditions: 1) the projectile is travelling at the maximum muzzle velocity, 2) the projectile enters the ground perpendicular to the ground surface, and 3) the item does not become deformed upon impact. In practice, the depth of penetration is less than that determined using a maximum velocity at vertical impact. Recovery data compiled from multiple UXO cleanup operations indicate that the majority of munitions are found at depths less than 2 feet (U.S. Army Engineer Research and Development Center [ERDC], 2004).

With the exception of mortars which are lobbed at a steep angle, and items fired into a berm or hillside, most munitions do not enter the ground perpendicular to the ground surface. At FTSW, the topography is flat on the anti-aircraft ranges, so projectiles were not being fired into hillsides. Therefore, the striking angle is anticipated to be shallow. Projectiles entering at a shallower angle will not reach the maximum penetration depth. Further, as presented in the ERDC publication TR-04-08 (*Guidelines for Planning Unexploded Ordnance [UXO] Detection Surveys*) (ERDC, 2004), after a projectile impacts the ground surface, it typically follows a J-shaped path. If the striking angle is low enough (< 20 degrees), it is possible for the projectile to return to the surface because of the J-curve path the projectile follows.

3.3.1.3 Physical Conditions

The topography of FTSW is relatively flat, with surface elevations varying from approximately 2 to 30 meters above msl. The majority of the Anti-Aircraft Range - 4B and Anti-Tank Range 90-MM-2 MRSs are undeveloped and forested. The majority of the Grenade Launcher Range is developed. Approximately 82,148 acres of wetlands have been identified on FTSW, which represents approximately 30 percent of the total area (see **Figure 7-1**). Wetland types identified at FTSW include black water swamps, bay forests, stream head pocosins, wet pine flat woods, and cypress-gum swamps. The following wetlands acreages are present within each MRS:

MRS	Wetlands (acres)
Anti-Aircraft Range - 4B	239.3
Anti-Tank Range 90-MM-2	73.4
Grenade Launcher Range	6.6

Field crews will operate on foot in wetland areas to limit impacts to wetland vegetation or associated water resources. As needed, geophysical transects will be moved to limit impacts to wetlands areas. Geologic and groundwater conditions are not expected to affect the proposed geophysical instrumentation.

3.3.1.4 Site Utilities and Man-Made Features

There are no known FTSW utilities expected that would impact geophysical investigations beyond normal power, water, and sewer lines that mainly follow roads. Other manmade features present will include fencing, roads, and buildings. Prior to any excavations, CB&I will obtain a dig permit in accordance with Georgia 811 "GAUPC.com."

3.3.1.5 Site-Specific Dynamic Events Affecting Geophysical Investigations

Dynamic events (rain, lightning, solar flares, etc.) may temporarily impact the geophysics survey. Procedures for these anticipated events are as follows:

- <u>Rain</u>—Depending on its intensity, rain can be a significant impediment to survey operations. The UXOSO and UXOQCS will assess the intensity of rainfall and its effects on survey instrumentation and safety (slip, trip, fall) considerations to determine when or how to proceed. General guidance for mitigating common conditions are:
    - <u>Drizzle or Intermittent Light Rain</u>—Tape plastic around instrument electronics and continue.
    - <u>Thunderstorm</u>—Take cover and cease operation until the storm passes.
    - <u>Continuous Medium or Heavy Rain</u>—Take cover and cease operations until conditions improve.
    - <u>Lightning</u>—Because most geophysical instruments contain sufficient metal and geometry to pose a preferred pathway for electrical discharge (lightning rod effect), observed lightning in the area will be deemed a safety hazard and will be cause for the cessation of survey activities until the lightning activity has ceased. All site personnel and equipment will shelter in a designated safe area.

3.3.1.6 Access Issues

Site conditions pose challenges in terms of site accessibility and system deployment impediments. The following general site conditions and remedies are expected at most remote sites:

- Poisonous Plants—To the maximum extent possible, these plants will be avoided during the surveys. If possible, they will be removed prior to surveying by brush cutting.
- Sensitive Habitats and Cultural Sites—In cases where surveying is coincident with the location of cultural sites or sensitive plant/animal habitats, access will be coordinated with FTSW.
- Thick Vegetation—Brush or high grass may be cut to access areas.
- Wooded Areas—Much of the area is wooded with overhead tree canopy that will affect GPS signals.
- Wetlands Areas—Wetlands are present within each MRS, however, the approach to investigation specified in this work plan is acceptable to FTSW. UXO technicians will complete transect though the wetlands whenever possible, or return for additional attempts at a drier time. Pumps may also be used to dewater small excavations. If standing water prevents the completion of transects in a significant portion of the wetlands, the acreage will be made up in other portions of the site. If there is a significant gap in data from one portion of the site, the information will be provided to the Project Delivery Team (PDT) for discussion and agreement on a path forward.
- Ponds and Streams—Ponds and streams may be present and should be avoided by adjusting transect paths around them.

3.3.1.7 Potential Worker Hazards

All site personnel will adhere to the practices, procedures, and training and monitoring requirements mandated by the APP (CB&I, 2014). Because of the potential MEC hazard, qualified UXO personnel will perform the investigations.

Other than the potential to encounter UXO, only the normal field-related hazards are expected. These include slip-trip-fall, poisonous and/or stinging flora and fauna, heat or cold stress, etc. All hazards are addressed in the SSHP and will be reviewed with the field team.

3.3.1.8 Survey Type

Analog magnetometers will be operated in mag and dig mode to complete the transects. EM61-MK2 geophysical sensors will be used in conjunction with RTK GPS, RTS, or fiducial positioning systems for 2D “full coverage” grid surveys. Additional details on the mag and dig investigation and DGM survey are presented in Sections 3.3.2 and 3.3.3, respectively.

3.3.2 Mag and Dig Investigation

The mag and dig investigation will be performed using a Schonstedt magnetometer (or equivalent). Magnetometers are ferrous metal detectors and detect only iron or magnetic materials. The depth of detection is limited by the size and orientation of the target and by soil characteristics. The instrument is not capable of classifying anomalies; it will only indicate the presence or absence of a magnetic anomaly.

3.3.2.1 Analog Test Strip

Prior to the mag and dig investigation, a daily test will be performed to ensure that handheld instrumentation is functioning properly. The instrument verification strip (IVS) described in Section 3.3.3.3 will be used as the analog test strip. Additional means of testing the quality of the analog survey will include blind seeds as specified in Section 4.3.

3.3.2.2 Analog Performance Metrics

The following analog performance metrics will be used at the magnetometer and dig sites:

- Repeatability—Instrument functionality will be sufficient to detect 100 percent of the items in the analog test strip. On a daily basis, each instrument operator will be required to sweep the test strip using the sweep techniques and instrument settings proposed for the project, and detect 100 percent of the items.
- Dynamic Repeatability—Instrument operators will consistently recover all anomalies. Ongoing testing will consist of re-sweeping at least 5 percent of each transect/mini-grid by a second party to verify that no additional items of a similar size/mass to the items of concern are found. If such an item is found during the re-sweep, the entire grid will be reworked.
- Coverage—Instrument operators will search all areas within each sweep lane. Ongoing testing will consist of coverage seeds (small pieces of metal that are easy to detect – 16 pennynails or equivalent) placed within sweep lanes at a rate of at least three per grid. All seeds must be recovered by the team; otherwise, the entire grid will be reworked.
- Detection and Recovery—Ongoing instrument and operator functionality will be sufficient to detect anomalies of similar size to the items of concern. Ongoing testing will consist of blind seeds placed within sweep lanes at a rate of at least one large/deep and one small/shallow per grid. All seeds must be recovered by the team; otherwise, the entire grid will be reworked.
- Anomaly Resolution—Ongoing instrument and operator functionality will be sufficient to clear all holes of items of concern. Ongoing second party anomaly resolution verification is integral to the anomaly excavation process, as anomalies are investigated by a two-person team.

3.3.2.3 Investigation Procedures

The mag and dig investigation will be performed using the magnetometer to locate and investigate ferrous anomalies. When an anomaly is identified, a qualified UXO technician (minimum UXO Technician II) will unearth the item using hand tools. Additional details on the Intrusive Investigation procedures are found in Section 3.5.

Personnel

All intrusive investigations will be performed by UXO qualified personnel as outlined in the Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18 (DDESB, 2004). Three 2-person UXO Teams will conduct the transect investigation, each consisting of one UXO Technician III and one UXO Technician I or II. The three teams will be supervised by the SUXOS and dual-hat UXOQCS/UXOSO.

Production Rates

Production rates are highly variable and depend on several factors including density of anomalies, topography, vegetation, site access, proximity of survey area, and weather conditions. CB&I anticipates that the teams will complete ½ acre per day based on previous work in similar terrain.

Geophysical Equipment

A Schonstedt handheld magnetometer will be for mag and dig operations. Based on our past experience and testing at the analog test strip, the Schonstedt has the ability to detect the items of the interest at the site to a depth of 1-2 feet below the surface. Instrument settings (sensitivity and volume) will be set in accordance with the Analog Performance Metrics.

The Trimble Geo XH (or equivalent) is a ruggedized handheld GPS that will be used to guide the sweep teams along the pre-defined transects and to record the information acquired during anomaly excavation, as necessary (a separate ruggedized Personal Data Assistant [PDA] containing the CB&I MEC software may also be used for this activity). The Geo XH can provide sub meter positions in areas void of tree canopy and has good tracking capabilities and accuracy in areas of canopy. It allows the user to enter comments while in route along each transect, and provides continuous updates for the offset from the intended transect route so that the sweep team can make real time adjustments when necessary.

Survey Procedures

Surveying will be achieved through deployment of the sensor system through the collection of pre-defined 1D transects or lanes and 2D grids. After collection, all traverses will be uploaded into the Geographic Information System (GIS) for verification of full coverage.

- Review the site to assess geophysical survey conditions.
- Confirm location control via checkshots to at least one other control point of known location.
- Perform initial instrument functional checks and document results.
- For transect surveying, define and follow specified transect paths. All transects will consist of straight-line paths to the maximum extent possible. Transects will consist of a single pass of the sensor system covering a 4-foot-wide swath.
- When positive responses of the analog sensor occur, stop and check a 2- to 3-foot diameter and intrusively investigate each “hit” using the procedures specified in Section 3.5. Record dig information using Geo XH.
- At the end of each transect, document the time in the Geo XH.
- Collect and maintain digital field logs to document the conditions of the data collection process. The data will include information and observations of the data collection area, field conditions, quality checks, and dig results
- Upload the information stored in the Geo XH to a field PC at least once per day. Back-up data to the CB&I server.
- Review all traverse data and overlay on the survey grid layout or planned traverse lines as QC and to ensure adequate coverage.

Instrument Standardization

Instrument standardization procedures are implemented to ensure accuracy and repeatability of all collected field data. Requirements for instrument standardization, minimum test frequency, and acceptance criteria are outlined in Section 3.3.3.

Equipment Function Checks

Equipment function checks will be performed at regular intervals during the project to ensure that the geophysical survey equipment is working according to manufacturer’s specifications and is appropriate for the intended survey activities. The UXOQCS will review the Equipment Verification documentation as part of the QC program.

Data Processing

No data processing is anticipated; however, the location positions recorded along each transect will be transferred into the project GIS to ensure the necessary coverage has been obtained. Information from the dig results will also be transferred to the site GIS so that spatial trends can be assessed.

Anomaly Excavation

Anomalies (or “hits”) from the analog detector(s) will be investigated in real time using the procedures specified in Section 3.5.

3.3.3 DGM Survey and Anomaly Investigation Methods

In selected accessible areas, a DGM survey and anomaly investigation will be performed to assess the potential for single subsurface 40mm or 90mm munitions and buried pits of DMM. Measurement Quality Objectives (MQOs) for the DGM surveys are established in **Table 3-5**.

For the DGM survey, the field team will be composed of two geophysicists or one geophysicist and one UXO Technician II.

Interpreted pits and discrete anomalies identified in the mini-grids for follow-up intrusive investigation will be submitted to stakeholders for concurrence, and a technical planning meeting will be scheduled if requested. The data may be submitted in more than one batch so that a partial set of anomalies can be investigated while DGM and data evaluation are ongoing.

Table 3-5
Measurement Quality Objectives for Digital Geophysical Surveys

Measurement Quality Objective	Test Method	DGM Measurement Performance Criteria	Corrective Action
Survey speed is appropriate for detection of 40mm items in DGM grids and DMM pits on transects.	Results of DGM surveys will be evaluated to ensure compliance.	95% of point-to-point speeds will not exceed 1.4 m/s. (Approx. 3 miles per hour maximum)	Data points above the maximum survey speed may be turned into gaps and evaluated using the survey coverage DQO.
Down-line data density is sufficient to detect 40mm items in DGM grids and DMM pits on transects.	Results of DGM surveys will be evaluated to ensure compliance.	95% of along-track gaps will not exceed 0.14 meters.	Gaps larger than 0.14 meters will be evaluated using the survey coverage DQO.
Across-track spacing is sufficient to detect 40mm items in DGM grids.	Results of DGM surveys will be evaluated to ensure compliance.	90% within 0.75 meters (2.5 feet) and 100% within 1.1 meters (3.5 feet).	Affected areas will be resurveyed or gaps will be filled.
Survey coverage is sufficient to meet project objectives.	Results of DGM surveys will be evaluated to ensure compliance.	100% coverage of accessible areas. Minor data gaps not due to obstacles or inaccessible areas will be limited to 1% of the total area to be surveyed.	Affected areas will be recollected or gaps will be filled.
Appropriate latency corrections are being applied.	Results of Latency Tests will be evaluated to ensure compliance.	No visible chevron effects in the data or pseudo-color plots.	Data will be reprocessed or file set will be recollected.

3.3.3.1 Survey Control

A preexisting survey monument established by a licensed Georgia surveyor of third order horizontal accuracy (residual error less than or equal to 1 part in 10,000) will be used to provide position information for the DGM survey either directly or by using the monument as a source to generate additional control points near the DGM survey areas. If control points are generated during the DGM activity, they will be validated by occupying at least one other independent control point.

A metal nail (e.g., 16 penny), 6- to 8-inch rebar section, or equivalent metal object will be placed at each transect endpoint or “full coverage” grid corner and a unique grid identifier written on a section of survey lath or a small tag. The actual survey coordinates as staked in the field will be digitally recorded and uploaded to the project database.

The metal objects at each grid corner or transect endpoint will be used as control point locations for the RTS, if used, as well as a QC check for the positioning accuracy and repeatability of the DGM surveys. All survey control will be developed in Universal Transverse Mercator (UTM) Zone 17, WGS 1984, Meters.

3.3.3.2 DGM System

Based on the results of previous work and knowledge of site conditions, CB&I will use an EM61-MK2 geophysical sensor coupled with an appropriate positioning methodology for spatial positioning for the DGM effort.

Deployment Platform

The EM61-MK2 DGM system will be deployed as a standard-height (i.e., lower coil 42 centimeters [cm] above the ground surface) wheeled cart system.

EM61-MK2 Geophysical Sensor

The Geonics EM61-MK2 is a four-channel high-sensitivity time domain electromagnetics sensor designed to detect ferrous and non-ferrous metallic objects with good spatial resolution and minimal interference from adjacent metallic features. Time domain electromagnetics sensors work by utilizing a transmitter that generates a pulsed primary electromagnetic field in the earth, which induces currents in nearby metallic objects. The current decay produces a secondary magnetic field measured by the receiver coils of the EM61-MK2. Measurements are acquired a relatively long time after the primary pulse at specified time gates, which allows the current induced in the ground to dissipate, leaving only the current in the metal to still produce a significant secondary field.

A single EM61-MK2 unit consists of two 1 meter by 0.5 meter rectangular coils arranged in a coaxial geometry and separated by 40 cm. Half meter coils have a higher sensitivity and spatial resolution than the larger 1 meter by 1 meter EM61-MK2 coils. Secondary voltages induced in the bottom and top coils are measured in millivolts (mV) by the instrument electronics and recorded to a Juniper Allegro data logger or equivalent.

The EM61-MK2 measures four time gates from the lower coil (216, 366, 660, and 1,266 microseconds – “4” mode) or the first three time gates from the lower coil and the 660 time gate from both the lower and upper coil, also known as “D” mode. For this project, four channels of the EM61-MK2 response from the lower coil will be recorded unless indications from the field would suggest that the “D” mode would provide better or additional information.

The EM61-MK2 was designed to detect individual small items at shallow depths and relatively larger items (e.g., 155mm projectile) at depths approaching 5 feet. The resulting data can be used to differentiate, in simplistic fashion, the relative size and distance (or depth) of metal items when the anomaly density is relatively low. In cluttered areas where the anomaly density is relatively high (e.g., burial pits, trenches, etc.) and the anomaly signatures overlap, the determination of size and distance (depth) is much more difficult.

Positioning Methods

In open areas void of tall vegetation and canopy, RTK GPS will be used to provide position information for the DGM system. In areas where there is interference from tree canopy an RTS may be used to provide positioning if the area of investigation is relatively small (i.e., several acres). Along transects in areas of heavy canopy the fiducial method may be used to provide positioning data for the geophysical measurements.

A Leica RTK GPS System 1200 or equivalent will be used for spatial positioning over a high percentage of the open areas at each MRS. The proposed RTK GPS utilizes a base station that is set up on a known position. Once the base station is set up, it determines its location using satellites and then applies a correction based on the offset from the known coordinates at the location. This correction is then used by a rover that is in direct communication with the base station through a radio link. The Leica System 1200 RTK GPS units are capable of recording survey-grade measurements in real time and providing immediate accuracy to within approximately 5 cm.

The Leica TPS1200 is a motorized RTS that uses automatic target recognition to track the location of the prism and has a highly accurate distance/azimuth measurement system to produce ± 2mm accuracy. The RTS system hardware consists of three integrated components: 1) the Leica TPS1200 dual-laser RTS, 2) the RTS rover remote link control panel, and 3) a survey prism that is tracked by the RTS base station. The position data are recorded onto a data storage card on the RTS. The data storage card can be used to transfer position data between the RTS and field computers. For DGM, RTS position data can also be output as a real-time data stream via a serial adapter from the remote link to the geophysical sensor's data logger.

In areas of extremely dense canopy or obstructions where obtaining accurate dynamic (i.e., moving) positions with the RTK GPS or RTS is difficult the fiducial method of positioning may be necessary. The RTK GPS will be used in static mode or RTS as necessary to determine approximate WGS 84-referenced locations at specified intervals along the transect segment where dynamic RTK GPS or RTS data cannot be acquired. Along each transect survey lathe or pin flags will be evenly spaced and electronic markers will be placed in the geophysical data file when passing by these waypoints during data acquisition. During data processing the EM61-MK2 measurements are interpolated between each waypoint using the known relative coordinates of the waypoints, and the relative coordinates are translated into the required state planar or UTM system using the RTK GPS information. For the fiducial method, the most important element is the accurate relative distance between each waypoint location. A tape measure will be used by the DGM field crew to measure the relative distance between each waypoint. An autonomous GPS system (Trimble Geo XH or equivalent) may be used for use for the burial pit survey near in heavily canopied areas in conjunction with the fiducial mode of positioning.

The wheel counter technique uses an internal counter attached to the lower EM61-MK2 coil to collect data measurements every 4 inches of distance traveled. The EM61-MK2 system is pulled in a straight line between two known (geo referenced) locations and the sensor measurements are translated from relative distance traveled from the origination location into actual geo referenced coordinates using the state planar or UTM locations of the known locations. In order to provide accurate position data, the terrain between the two known locations should be relatively flat and smooth. This method may be used in areas of thick brush or tree canopy where RTK or RTS methods may not work accurately.

The determination of the specific positioning method (RTS, fiducial, or wheel counter) will be addressed during reconnaissance activities during the initial stages of the field program. In addition to providing position data for the geophysical sensor measurements, the RTS or GPS will be used for other location tasks including:

- Feature Identification—The RTK GPS, autonomous GPS, or RTS will be used to augment geophysical data and improve geophysical mapping by capturing of visual observations made during the site walk-over. During this process, the GPS will be used to record the location of thick vegetation, extreme topography, and, manmade features such as wells, fences, etc., so that these features can be accounted for during the analysis and interpretation of the geophysical data.
- Anomaly Reacquire—RTK GPS, autonomous GPS, or RTS will also be used for anomaly reacquire. The coordinates for each interpreted anomaly will be uploaded to the RTK GPS rover or RTS and the "stakeout "mode of operation will be used to reacquire each location to an accuracy of 0.15 meters (0.5 feet). For fiducial transects, the relative distance is measured with a tape measure anchored at a transect endpoint to relocate anomalies.

Position data for the project will be reported in the UTM Zone 17, WGS 1984, Meters.

3.3.3.3 Instrument Verification Strip Plan

CB&I proposes to use an IVS approach to validate the EM61-MK2 sensor, positioning methods, and data acquisition protocol for the DGM single buried metal source mini-grid survey effort. A separate test strip is proposed to validate the handheld sensors used for the analog geophysical survey (Section 3.3.2.1). Prior to construction of the IVS by CB&I field crews, a surface and vegetation clearance of the proposed IVS location will be performed. After the clearance activities have been completed, a background geophysical survey will be performed using the EM61-MK2 over an area of approximately 0.125 acres. If anomalies are present during the background survey, the IVS will be positioned within the area to minimize their effect. Anomalies that are detected during the background survey may be removed prior to construction of the IVS by qualified UXO technicians if approval is granted by the client.

An IVS is not proposed to validate the use of the EM61-MK2 for detecting large-scale features such as burial trenches and pits as the ability of the system to perform that task has been well documented, and it would not be cost effective to simulate large-scale burial conditions for the purpose of proving the application of the instrument. However, instrument functional checks will be performed prior to the project start and at the start and end of each day to ensure the sensitivity and repeatability of the EM61 and the RTK GPS, RTS, or fiducial positioning methods.

The IVS will consist of three small industry standard objects (ISOs) as shown in **Table 3-6**. The ISOs will be buried at approximately 0.2 to 4.5-foot depths at horizontal (long axis perpendicular to IVS centerline) and vertical orientations, respectively, approximately 15–20 feet apart in a "background" area (i.e., area void of subsurface metal and electromagnetic interference). The positions of the IVS items will be recorded to an accuracy of 3 cm (1.2 inches). The IVS construction will follow the guidelines in Chapter 3 of the DGM QC Guidance (USAESCH, 2003).

Table 3-6
DGM Test Strip Design

Item	Number of Items	Burial Depth (feet) and Orientation		
		A	B	C
Small ISO 1"x4" Black Steel Pipe Nipple	3	2"H	4"V	5"H

Notes: Depth is to the center of the item.
H – Horizontal
V – Vertical

The ISOs will be used to confirm the sensitivity of the geophysical instrumentation and adequacy of the data acquisition parameters (line spacing, sampling frequency, positioning system accuracy and precision, and sensor height above the ground surface) by comparing the sensor responses from the ISOs to standardized, physics-based models of the ISOs created specifically for munitions response projects by the Naval Research Laboratory (NRL). Multiple acquisition lines will be collected at offset distances from the IVS in order to determine the site-specific "noise," which is an important component in determining the anomaly selection criteria. For areas where the depths and types of MEC are not known from previous investigative activities, the minimum threshold for anomaly selection will be three to five times the site "noise." Responses from the inert munitions will also be used as supplementary information for the interpreter in defining the initial anomaly selection criteria for the project. Specifically, five parallel lines (three on each side of the IVS centerline) spaced at 1.25-foot intervals will be collected to provide a complete, 2D view of the anomaly characteristics. A "noise" line will be collected parallel to the IVS centerline at an offset distance of approximately 15–20 feet to assess the background noise at the site. **Figure 3-8** shows the IVS design.

If aboveground power line interference is present near any of the geophysical survey areas, static geophysical sensor data will be acquired prior to the initiation of survey activities so that the information can be incorporated into the anomaly selection criteria.

The results of the pre-project instrument tests and the initial IVS will be submitted in a letter report to USACE for review and approval and will include, at a minimum, the following information:

- As-built map of the IVS
- Digital photographs of the inert and ISO seed items as used and in the open hole
- Graphical plots of the EM61-MK2 DGM system responses for the ISOs superimposed on the NRL standardized curves as well as a summary table of EM61-MK2 responses for each IVS item
- Color-coded maps of the geophysical data with track path superimposed
- Geophysical interpretation, including initial anomaly selection criteria
- Proposed geophysical equipment, techniques, and methodologies
- Recommended QC performance metrics
- Digital data and project MS Access Database

CB&I assumes that a USACE representative will be on site or otherwise available during the initial IVS to discuss results and provide real-time concurrence. Concurrence of the IVS results will be based on meeting the following metrics:

- Background static geophysical sensor check—Ninety-five percent of the static measurements for each of the EM61-MK2 channels will be within 2.5 mV of background after instrument nulling.
- IVS check—The responses for the EM61-MK2 from small ISOs (surface and 0.2 foot deep vertical) will not fall below a secondary detection band placed 25 percent below the lower boundary of the respective NRL detection curves. The allowable position offset will be ± 0.37 meters (1.2 feet) based on the location of the Channel 2 peak response compared to the location of the center of each ISO. 0.37 meters (1.2 feet) is one-half of the line spacing that will be attempted for the full coverage DGM grids. If the position of the item is evaluated based on the gridded data, the location of the item will be within 0.73 meters (2.4 feet) of the actual location.
- Background dynamic geophysical sensor check—The standard deviation for dynamic noise at the IVS (i.e., areas where no metal is present) for all EM61-MK2 data channels will not exceed 2.0 mV, based on leveled data. The metric may be modified based on the initial results of the IVS and any modifications will be documented in the IVS report.
- Known location check—The acceptable difference in location measurement at a grid corner, survey monument, or control point at the IVS in static mode will be less than or equal to 0.15 meters (0.5 feet).

If the deployment form for the DGM system is modified the IVS must be rerun. In addition, if multiple DGM systems are used (e.g., RTK GPS, RTS, or fiducial positioning), each individual system must be run through the IVS. This will be performed during the IVS that will occur twice per day during the production survey. As part of the IVS effort, all instrument functional and quality tests will be digitally documented and stored in the project MS Access Database for review by the client and stakeholders.

3.3.3.4 Daily Instrument Checks

The following tests will be performed at the beginning and at the end of each data collection day to insure all equipment are functioning correctly. The results of the test are digitally documented using the project MS Access Database.

- Equipment Warm-Up—Most instruments require a few minutes to warm up before data collection begins to minimize sensor drift due to thermal stabilization effects. All instruments will be allowed to warm up for at least 5 minutes before data collection. This procedure will be followed each time the instrument is powered up (e.g., at the start of the day, power supply changes, after breaks).
- Record Sensor Position—At the beginning of the survey, and thereafter at any changes in form factor, or when a sensor is reattached to a pole or cart, the relative positions of the geophysical sensors with respect to the positioning system antenna or prism will be measured (tolerance ± 1 inch) and documented, as will the platform or sensor height above the ground surface.
- Static Background Test—The Static Background Test monitors the instrument background readings, monitors for electronic drift, and identifies potential interference. With the instrument held in static position, measurements are recorded for a period of 30 seconds (the initial test at the start of the project may be recorded for duration of 3–5 minutes). Ninety-five percent of static background readings for the EM61-MK2 will remain within 2.5 mV of background for each of the data channels. Revisions to this metric may be proposed by the site geophysicist based on site conditions, subject to approval by USACE. The test is performed at least twice daily, prior to the first data acquisition session and after completion of data collection. The results of the Static Background Test are digitally documented using a spreadsheet.

- Static Spike Test—The Static Spike Test monitors the impulse response and repeatability of measurements over a standard test item. For the EM61-MK2, the standard test item is placed at a predefined location on the EM61-MK2 on a rigid bracket or tube and measurements are recorded for a 30-second duration. The resulting response of the test item will be measured and documented for all electromagnetic channels. An average of the first four tests for each channel will be used as the baseline response. Ninety-five percent of measurements for the response of the standard test item should be within 10 percent after subtraction of the sensor baseline response. The test is performed at least twice daily, prior to the first data acquisition session and after completion of data collection. The results of the Static Spike Tests are digitally documented using a spreadsheet.
- Personnel Test—The Personnel Test is performed to check the influence of personnel-carried metallic items (e.g., keys, boots, belt buckles) on the manEM61-MK2 sensor. With the instrument held in static position, the operator(s) move around the sensor while measurements are being recorded for a period of 15 seconds. The measurements for all data channels of the EM61-MK2 will remain within 2.5 mV of background. The test is performed at least once daily, prior to the first data acquisition session and after any personnel changes.
- Cable Shake Test—The cable shake test is performed at the beginning of each day to document any cable or connection problems. This is done for all geophysical sensor platforms. With the instrument motionless and recording data, each data cable is shaken and cable connector is wiggled to test for shorts or bad connections. Data collected during the Cable Shake Test will be free from spikes greater than 2.5 mV for each of the EM61-MK2 data channels.
- Latency Test—The Latency Test measures the time latency in the instrument readings. All the instruments have a built-in latency between the measurement and the output of the reading. To measure this latency, the sensor platform moves over a standard test item in a consistent heading, then back over the same item following close to the original path. This test is performed at the start of each survey day. The time difference is assumed to be linear throughout the day. The results of the Latency Test will be applied to the survey data for that day.
- Known Location Test—The Known Location Test checks the function and accuracy of the positioning system. The GPS or RTS antenna is positioned over a known, surveyed point that has been established nearby and the observed location is compared to the known location. In order to pass, the two locations must be within 15 cm of each other.
- Background Dynamic Geophysical Sensor Check—The standard deviation for dynamic noise at the IVS (i.e., areas where no metal is present) for all EM61-MK2 data channels will not exceed 2.0 mV, based on leveled data. The metric may be modified based on the initial results of the IVS and any modifications will be documented in the IVS report.
- IVS Repeat Data—The repeatability of geophysical mapping data is monitored by the collection of replicate data over the IVS items. During the initial test, 10 runs of the IVS centerline will be performed, and an average response will be calculated for each IVS item. The responses for the EM61-MK2 from small ISOs (surface and 0.2 foot deep vertical) will not fall below a secondary detection band placed 25 percent below the lower boundary of the respective NRL detection curves. The allowable position offset for each ISO or inert MEC item will be ± 0.37 meters (1.2 feet) based on the location of the Channel 2 peak response compared to the location of the center of each ISO. The 0.37 meters (1.2 feet) is one-half of the line spacing that will be attempted for the full coverage DGM grids. If the position of the item is evaluated based on the gridded data, the location of the item will be within 0.73 meters (2.4 feet) of the actual location. If any items buried along the IVS produces an EM61-MK2 response characterized by two peaks, the trough between the two peaks will be used as the basis for the position offset and the larger of the two peaks will be utilized for amplitude readings.

3.3.3.5 DGM Surveys

DGM surveys will be conducted with single unit EM61-MK2s integrated with RTK GPS or RTS units for positioning. The metrics for DGM surveys are summarized in **Table 3-7**.

Table 3-7
DGM Survey Data Collection Specifications

Metric	
Survey Speed	95% less than or equal to 1.4 m/s
Down Lane Spacing	95% less than 0.14 meters apart
Across Lane Spacing (DGM Grids)	90% within 0.75 meters (2.5 feet) and 100% within 1.1 meters (3.5 feet)
Dynamic Background Noise	2 mV
Spatial Accuracy	0.3 ± 0.2 meters

3.3.3.6 Data Processing

CB&I's standard data processing includes review of data in the field for general quality followed by more intensive analysis at the data processing center to include latency and drift correction, statistical assessment of the DGM performance metrics, and generation of color coded images of the EM61-MK2 data channels and track path. CB&I will use the following software to process the data:

- Geonics Dat61MK2 for review of data ranges and output of a merged file with positions in American Standard Code for Information Interchange (ASCII) format
- Geosoft Oasis Montaj for latency and drift corrections, interpolation and generation of color-coded images, and statistical analysis of the data in terms of the performance metrics such as spatial sample density, static, and static spike responses
- Leica GeoOffice or equivalent may be used for location survey and cultural feature mapping tasks, as well as for statistical review of position data

Geosoft Oasis Montaj will be the primary software used for most data processing tasks.

3.3.3.7 Data Organization, Initial Processing, and Data Tracking

The data processing begins by organizing the data on the CB&I server. The raw data for the DGM sensors will be copied to the "proc" directory for further processing and will never be compromised so the sequence of events can be reconstructed in the future, if necessary. The raw binary data are converted to an ASCII format using Geonics Dat61MK2 software and concurrently reviewed to ensure the sensor and positioning equipment are functioning properly and that the data are accurately positioned along survey lines and corrected for acquisition geometry. The final step of the process includes output of an ASCII "XYZ" file that includes the coordinates (UTM Zone 17, WGS 1984), sensor measurements for each data channel, and a quality indicator for the positioning device. The format of the "XYZ" file will be consistent for the project and compatible with Oasis Montaj.

Each data acquisition file name is digitally documented using the project database or spreadsheet.

3.3.3.8 Review of Instrument Functional Checks

The ASCII data from the initial processing are imported into Oasis Montaj using a pre-defined processing script. The QC data for each morning and afternoon test sequence are reviewed by the data processor to document compliance with the performance metrics. The general steps performed include the following:

- Review of Geophysical Sensor QC Data—Sensor QC test results (static background and spike tests, cable shake test and, personnel test) will be reviewed to ensure proper system function. This step validates the repeatability and sensitivity of the geophysical sensor and the standard response to known items in both static and dynamic modes of operation, as well as provides information on the background noise in the survey area. Conformance with the performance metrics specified in **Table 3-7** and Section 3.3.3.4 is digitally documented for each data acquisition session.

- Review of Position and Spatial Sampling QC Data—Positioning system and spatial sample density QC test results (sensor velocity, comparison with a known control point, and along and across track measurement spacing) will be reviewed to ensure proper system function. This step validates the repeatability and accuracy of the positioning system as well as the overall data acquisition protocol in terms of the navigation procedures. Conformance with the performance metrics specified in **Table 3-7** and Section 3.3.3.4 is documented digitally for each data acquisition session.

For each data acquisition file, a unique line code will be entered into the Oasis Montaj geodatabase that documents the date of acquisition and responsible crew if more than one geophysical crew is performing at this site.

3.3.3.9 Final Data Processing

The data processor will use Oasis Montaj scripts for each data acquisition file to process the EM61-MK2 data channels prior to generating color-coded images used for analysis and interpretation. The minimum curvature gridding routine will be used to interpolate the data using a cell size, blanking distance and initial search radius based on the survey's across line spacing. The color-coded images will be transcribed onto the plan map of the site for analysis and interpretation.

Additional tasks during the final data processing include deletion of turnarounds and overlapping data past the edge of the defined data acquisition area (i.e., grid edges) and examination of the data with respect to the location of cultural or natural features (wells, trees, utilities, etc.) observed on the site base map. If any data gaps are present, the data processor will digitize the area and transfer the coordinates to the Site Geophysicist for subsequent data acquisition.

3.3.3.10 Anomaly Selection

The EM61-MK2 data will be used to select the optimum locations for potential exploratory trenching at potential burial pit areas in the firing point areas. The overall shape and signal intensity of the anomalies will be the primary components used to interpret the data.

3.3.3.11 Anomaly Reacquire

Reacquisition consists of relocating the interpreted coordinates for each interpreted anomaly. To locate the ground position of the interpreted anomaly coordinates, the navigational system "Stakeout" mode will be used for the RTK GPS or RTS positioning system. A non-metallic pin flag, labeled with the unique anomaly ID, will be placed in the ground at the interpreted location. If necessary, the boundaries of the areas of anomaly saturation will also be staked or marked in the field during the anomaly reacquire task.

Reacquisition of the interpreted location of the individual pits and potential MEC anomalies will be performed to ± 0.5 foot of the coordinates specified. This location will be the initial origin for the further evaluation of the anomaly using an EM61-MK2 (peaking). For transect surveys, a rectangular area whose long axis is perpendicular to the direction of travel of the instrument will be searched and a pin flag positioned at the peak instrument response. Based on past experience, CB&I anticipates the search rectangle will be approximately 5 to 6 feet wide by 2 to 3 feet long. At each location a non-metallic flag or other suitable mark (e.g., spray paint on road surfaces) will be placed with a unique target ID. The reacquisition team will be provided with a color-coded image of the sensor data to facilitate the efficient reacquisition of each potential pit.

Note that for this effort the only instrument QC tests that are performed and documented are as follows:

- Static Spike
- Static Background
- Cable Shake
- Personnel
- Known Location

3.3.3.12 Anomaly Excavation

Following anomaly reacquisition, UXO Technicians will perform an intrusive investigation. Additional details on the intrusive investigation procedures are provided in Section 3.5.

3.3.4 Hole Checks

After the UXO team has completed excavations in a grid, a geophysicist will return to all excavation locations and record the post-excavation anomaly peak values with an EM61-MK2 to verify that the source of the anomaly has been removed. The lead field geophysicist for the reacquisition team will null the EM61-MK2 in a clean location representative of background conditions, i.e., areas free of metal or influenced by cultural or external sources of noise, periodically throughout day and as necessary or whenever instrument drift or influence from external noise (e.g., electrical lines) is apparent. Data will be obtained in real-time, and the sensor data will be noted and recorded (hard copy or electronic). If the sensor data are determined to be below anomaly selection threshold, the test will be considered completed and the excavation will be backfilled. If the sensor data are determined to be above selection threshold, the excavation will continue to detection depth.

Hole check values may be below threshold where no apparent source object can be identified and may be considered a “no-find.” This may be the result of a surface object that has been moved since the original DGM data were collected, a positioning or data collection error, a hard bump to the EM61 during data acquisition, outside interference, or a processing artifact (such as edge effects) or similar cause. These conditions will be reviewed and documented. “No finds” in excess of 15 percent of the total number of targets in a grid will require a root cause analysis to be performed by the QC Geophysicist and reviewed by the Project Geophysicist. Subsequent to hole checks, all target results will be examined by the QC Geophysicist to confirm that the source of the anomaly was removed or to provide proper documentation for those targets where a source could not be confirmed. If a “no find” occurs with a signal-to-noise ratio of 5 or greater and has an array footprint that is evident on two or more lines of data then the QC geophysicist will examine the details and initiate additional investigation, if necessary, for acceptance.

For this task on, the EM61-MK2 is required. The required daily tests for the EM61-MK2 include:

- Static Background
- Static Spike
- Cable Shake
- Personnel

3.3.5 Geophysical Quality Control

Geophysical QC ensures proper execution of all components of the DGM work. All data are collected, processed, and delivered following strict QC procedures.

Data quality is assured and validated through the following activities:

- Evaluation and documentation of the repeatability of data collection, processing, and detection capabilities using multiple datasets collected using repeated survey parameters

- Comparison of final processed results against known ground data

3.3.5.1 Measurement Quality Objectives

Table 3-7 outlines the RI data collection specifications. **Table 3-5** lists the MQOs for geophysical surveys conducted by CB&I.

As part of the QC program, MQOs will be monitored during the course of DGM activities. These MQOs provide a means to quantify the quality of the data.

3.3.6 Blind Seed Program

Blind seed items (ISOs) will be placed in full coverage DGM min-grids used to detect potential single MEC items such that each DGM team will encounter at least one seed item per day. Seeds will be placed to attempt consistent detectability and will be recorded with an RTK GPS to provide accurate locations for evaluation of the DGM data quality. Small ISOs will be used as seed items. The QC geophysicist will utilize a Microsoft® Excel spreadsheet or Microsoft® Access to document the blind seed item type, depth, orientation, and actual coordinates. These data will be merged with the results from the interpretation, which include the EM61-MK2 signal intensity and interpreted coordinates. After the interpretation for a grid is submitted to the client, the blind seed information for that grid or area may be released to the data interpreter, if necessary.

If a blind seed item is not selected as a potential target of interest during the interpretation, or does not meet the blind seed item positioning metric, a root cause analysis will be performed. Based on the analysis of the information, corrective action(s) will be proposed to the CB&I PM and client. Corrective actions may consist of re-processing or re-collecting data, or adjusting the interpretation criteria and/or protocol.

3.3.7 Corrective Measures

The objective of the geophysical investigation is to locate, excavate, and record information that can be used to estimate the extent of MEC and/or pits of DMM within each survey area. In the event of a performance metric or DQO failure, the corrective measure will generally include a re-investigation of the transect or grid in which the failure occurred. CB&I's Project Geophysicist and the UXOQCS will perform a root-cause analysis to identify the reason for the failure, to identify how much data have been affected, and whether and what corrective actions are appropriate to correct, mitigate, or eliminate the cause of the failure. The root-cause analysis will be submitted to the client.

In the event that a particular geophysical method, instrument, or procedure is not generating meaningful results or advancing the project goals, CB&I will convene a review team consisting of the CB&I's PM, the Project Geophysicist, and USACE client personnel to investigate the cause and determine the corrective action.

Basic corrective measures will be implemented as part of day-to-day activities (i.e., replacing faulty equipment). USACE will receive written notification of all actions taken. If an instrument or process cannot be corrected to meet a performance metric or DQO, CB&I will cease using that instrument or process and make recommendations to USACE. These recommendations may include modifications to this work plan. CB&I will implement the amended plan upon approval from USACE.

3.3.8 Records Management

The geophysical investigation data will be uploaded to the project GIS on a daily basis and backed up on the CB&I server. GIS files will be managed by the GIS Manager and stored within the standard GIS subdirectory structure with README files in each directory containing a description of the contained files. GIS record management QC is discussed in Section 3.5, Geospatial Information and Electronic Submittals.

3.3.9 Interim Reporting and Submittals

Access to interim geophysical survey data will be provided via a project SharePoint site. All digital data will be provided in formats compatible with the USACE computer systems. Interim data will include the following:

- Track path for each sweep team
- Raw and processed DGM data, with associated README files
- DGM QC results summary in Microsoft® Excel format or Access® Database
- Final processed / interpreted data for each grid as Oasis packed maps and geodatabases
- Dig sheets from the geophysical interpretation as Microsoft® Excel spreadsheets
- Anomaly resolution information in Microsoft® Excel format or Access® Database
- Analog quality system records for instrument functional tests and daily quality checks performed by the UXOQCS in Excel format

The draft data will be available within 3 days of data collection.

3.4 GEOSPATIAL INFORMATION AND ELECTRONIC SUBMITTALS

The Geospatial Information and Electronic Submittals plan is used to describe the methods, equipment, and accuracy for conducting location surveys and mapping during the FTSW RFI, and the subsequent development of the project GIS databases to support the mapping and document production process. This section was drafted using the general instructions outlined in DID MR-005-07.01, Geospatial Information and Electronic Submittals.

Survey and/or geophysical activities will be performed as part of the FTSW RFI. All geospatial data generated during the course of this project will be incorporated into the project GIS.

3.4.1 MEC Tracking

PDAs equipped with the CB&I MEC data management system will be used to record and track MEC, MDAS, and other metallic items identified during the course of the investigation. The Environmental Information Management System (EIMS) will be populated with dig information from the anomalies detected during the analog geophysical investigation. EIMS has the capability of recording the type, weight, size, and other characteristics of MEC, MDAS, and other metallic items observed during the surface clearance and analog geophysical investigation. The northing and easting location of all MEC will also be recorded and tracked in the PDA.

An Arcview GIS map will be delivered to the client with the location of the proposed and actual transects, anomaly locations and dig results, and other features of interest such as surface finds, craters, or depressions, etc.

3.4.2 Accuracy

Semi-permanent and permanent control monuments established by a licensed Georgia surveyor will be of Class I, Third Order accuracy.

3.4.3 GIS Incorporation

Geo-referenced information generated during the course of the project will be incorporated into the project GIS. The project GIS will be used for map development and progress tracking. The project GIS will be used to quickly plot MEC locations and determine the most appropriate MSDs for demolition activities.

3.4.4 Mapping

Maps will be developed UTM Zone 17, WGS 1984, Meters.

3.4.5 Computer Files and Digital Data Sets

All GIS files will be compatible with ArcGIS. Data will be available electronically on CD or DVD upon request.

3.5 INTRUSIVE INVESTIGATION

This project involves using geophysical instruments to identify metallic anomalies to be excavated by CB&I UXO personnel. This section presents the procedures to be followed for such intrusive investigations.

CB&I will provide all necessary qualified personnel and equipment to perform intrusive anomaly investigation. Intrusive investigation will follow all applicable USACE and DoD guidance.

3.5.1 Accountability and Records Management for MEC

CB&I will maintain a detailed accounting of all MEC items encountered. Data from intrusive investigations and surface findings will be entered in the GIS database and included in the RFI Report.

Data collected regarding MEC found will include the standard official nomenclature, condition of the item, depth located, orientation of item, location coordinates, and final disposition. A digital photograph of each type of MEC item and significant/unusual items recovered will be taken and entered into the GIS database.

MDAS will be tracked in the database as MDAS along with its nomenclature if discernible. The total weight of collected MDAS will be documented from the munitions and range debris turn-in procedure (see Section 3.6) and documented in the final report.

3.5.2 Personnel Qualifications

All intrusive investigations will be performed by UXO qualified personnel as outlined in the DDESB TP-18 (DDESB, 2004).

3.5.3 MSD and MGFD

MSD restrictions at each MRS for non-essential personnel will be applied during all surface and subsurface investigation, removal, and disposal activities. Preliminary site work such as surveying, laying transect lines, and anomaly detection do not require the establishment of an MSD as MEC avoidance techniques will be used. The size of the MSD is based on the MGFD. The MGFD for each MRS and calculated MSDs are provided in **Table 3-8**.

Table 3-8
Minimum Separation Distances

MRS	MGFD	MSD (feet)			
		For Unintentional Detonations		For Intentional Detonations	
		HFD	TSD K40	w/out Engineering Controls	Using Sandbag Mitigation
Anti-Aircraft Range - 4B	2.75-in,M229, HE Rocket	308	71	1,434	200
Anti-Tank Range 90-MM-2	90mm, M71 HE Projectile	288	50	1,939	200
Grenade Launcher Range	40mm, M407 Practice Grenade	NA	11	330	200

For intrusive activities where there is a potential for unintentional detonations, the MSD for non-essential personnel is the greater of the Hazardous Fragment Distance (HFD) and the K40 distance for the MGFD. Essential personnel are defined as those on-site contractor and DoD personnel required to participate in the MEC activities, along with those approved and authorized visitors. All other personnel are non-essential personnel.

For intentional detonations, the MSD for all personnel from the Blow-in-Place (BIP) site will be based on the larger of the fragmentation distance and the K328 distance. The actual MSD will depend on the amount of donor charge used calculated as follows:

$$K\ (NEW)^{1/3}$$

where:

K = the K-factor (328 for intentional detonations)
NEW = the net explosive weight in pounds (including the donor charge)

During the course of the investigation, if MEC with a greater fragmentation distance is encountered, the MSD will be adjusted in accordance with DDESB TP-16, operations will continue and an amendment to the ESP submitted for approval.

3.5.4 Anomaly Investigation Procedures

Prior to any excavations, CB&I will obtain a dig permit in accordance with Georgia 811 “GAUPC.com.”

UXO Technicians will investigate each target anomaly by using small hand tools such as shovels, spades, and trowels to access anomaly targets. The following procedure and basic techniques will be used for excavation:

1. The UXO Technician will locate the anomaly with a metal detector.
2. Until the anomaly is otherwise identified, it will be assumed that the anomaly is Material Potentially Presenting an Explosive Hazard (MPPEH). Excavation will be initiated adjacent to the anomaly. The excavation will continue until the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with a metal detector or until the maximum depth of 4 feet bgs is reached.
3. The excavation team will expand the sidewall to expose the metallic item in the wall of the excavation for inspection and identification without moving or disturbing the item.
4. Once the item is exposed for inspection, the excavation team will make an initial determination as to its explosives safety status (i.e., whether it will be considered MDAS or Material Documented as an Explosive Hazard [MDEH]). If the item is determined to be MDAS, it will be removed and the area will be rechecked with the metal detector to ensure that a hazardous item is not hidden beneath it. The excavation team will then annotate the results of the excavation on the geophysical anomaly tracking sheet and move on to the next subsurface anomaly.
5. If the item is determined to be MEC, the excavation team will flag the item and inform the SUXOS and UXOSO.

3.5.5 MEC/MPPEH Identification

All recovered MPPEH items will be visually inspected for the presence of explosive or other hazardous material. A UXO Technician III or above will inspect all MPPEH before it is removed from the investigation area, and if no hazards exist, classify it as MDAS. Further storage, processing, certification, and disposal of MDAS will be performed in accordance with Section 3.6.1. If it cannot be positively classified as MDAS, it will be treated as MEC until otherwise determined to be MDAS.

UXO Technicians will make every effort to identify MEC through visual examination of items for markings and other identifying features such as shape, size, and external fittings. Items will not be moved during the inspection/identification until the nature and condition of the item can be ascertained. The SUXOS and the USACE OE Safety Specialist will agree on the positive identification and disposition of the item prior to implementing any disposal operations. The following general ordnance safety guidelines will be followed:

- In general, all ordnance will be considered armed unless determined otherwise.
- Color-coding will NOT be used for positive identification of contents. Munitions having incomplete or improper color-coding have been encountered.
- Practice munitions will be assumed to contain a live charge until it can be determined otherwise.

CWM is not expected to be encountered at the MRSs. If CWM is encountered, normal site activities will immediately stop until the CWM has been recovered and removed from the site. Field teams will immediately notify the SUXOS and evacuate the site along cleared paths at least 450 meters upwind. The SUXOS will account for all field personnel and notify the PM and USACE OE Safety Specialist or other USACE representative. USACE will initiate notification of the nearest EOD unit. Before work can resume, the site plans will be reviewed for adequacy in consideration of this newly discovered hazard.

3.5.6 MEC Removal

MEC will be disposed by BIP and therefore will not be moved. If there is a need to relocate an unfuzed item for disposal due to safety concerns or to consolidate shots, this will be done in coordination with the USACE OE Safety Specialist.

3.5.7 MEC Storage

There will be no established MEC storage at FTSW for this project. However, if items are located that cannot be BIP on the same day, due to interferences with the base mission, etc. the coordinates of discovered MEC will be recorded and disposal will occur as soon as feasible as coordinated with USACE and FTSW. A 24-hour guard will be needed in these situations unless other arrangements are made that are acceptable to both FTSW and USACE.

3.5.8 MEC Disposal

CB&I will be responsible for destroying MEC encountered. No explosives will be stored on site, so donor charges will need to be ordered from the explosives vendor for delivery to the site on an as-needed basis.

Area Notification/Evacuation Procedures. Prior to any detonation, a pre-established notification procedure will be initiated. As soon as it is determined that a detonation will be required, the SUXOS will notify USACE and FTSW. The SUXOS will schedule the demolition to allow sufficient time to complete all notifications, approvals, and evacuations as required. FTSW DPW will notify all appropriate FTSW agencies, which at a minimum will include Fire and Medical first responders, Police/Security and Base Operations, if required.

Demolition Procedures. During demolition activities, the SUXOS will maintain overall control of the site. An exclusion zone (EZ) will be established around the demolition site according to the MSD for intentional detonations stated in Section 3.5.3. Evacuation, if necessary, will be coordinated with local Military Police, law enforcement officials and local residents as required by the EZ. Only the SUXOS, the UXO team, UXOSO, and the USACE OE Safety Specialist will be allowed within the EZ once the demolition operations have begun. The UXOSO will ensure safe work practices are followed, and the UXO Technician III will perform the necessary steps to safely dispose of the MEC. The following general procedures will be adhered to:

- The SUXOS will be responsible for planning, directing, and executing all disposal operations.
- The UXOSO/UXOQCS will ensure that all work is performed safely and in accordance with the approved site-specific plans.
- A minimum of three UXO Technicians per team will be used to conduct disposal operations.
- One UXO Technician III will be designated as the Demolition Supervisor (DS).
- Two UXO Technicians (Level I, II, or III) will assist the DS, and one will act as a safety observer.
- The safety observer will be located in the safe area and will maintain in visual contact with the team down range. He will maintain communications with the team and the SUXOS.
- The UXO Disposal Checklist (**Appendix D**) will be completed for each disposal operation.
- Explosive materials of the type and quantity required, ordered, and delivered to the project site will be transported to the work site.
- Initiators will always be transported in a separate container from the donor explosives.
- The DS and assistant(s) will perform the appropriate tests for the type of firing train being used (Nonel and blasting caps, electric blasting caps, remote firing device, blasting machine, etc.). When complete the DS and assistant(s) will prime the shot and return to the safe area.
- The SUXOS will verify that the EZ is clear and barricades are in place.
- The SUXOS will give a “5-minute warning” and a “1-minute warning” on the horn and radio.
- The DS will give three loud “Fire-in-the-Hole” warnings.
- The SUXOS will give the “fire” command on the radio and the DS will initiate the firing train.

- The team will wait a minimum 5 minutes after single shots or 30 minutes after multiple shots that could not be counted before returning downrange.
- The DS and one other UXO technician will return to the detonation site and check the results of the shot. If the procedure was successful, the DS will call in additional personnel to clean up the site. UXO personnel will conduct a visual sweep of the detonation site and the immediate area to gather fragments and explosive residue, if present. After verification that no more detonations will be required, an "all clear" notification will be sent out to all parties on the notification list. CB&I UXO personnel will backfill all access/excavation/detonation holes. The area will be restored to its prior condition.
- Techniques described in EODB 60A-1-1-31 will be used during all demolition operations.
- In the event of a misfire, a 30-minute waiting period will be observed for shock-tube-initiating systems. A misfire checklist will be completed by the DS and filed with the daily logs.

Engineering Controls. Engineering controls, for demolition operations, will be used as delineated in the "Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions," HNC-ED-CS-S 98-7, dated August 1998 or in the "Use of Water for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions," HNC-ED-CS-S-00-3, dated September 2000. These controls will be applied, as needed, to mitigate fragmentation and blast hazards created during demolition operations, for single item detonations.

Consolidated Shots. Consolidated shots are not anticipated for this RFI. If used, the K328 overpressure distance may not exceed the maximum fragment distance. To calculate the total allowable net explosive weight (NEW) of the consolidated shot, divide the maximum fragment distance for the MGFD by 328, cube the result and divide by 1.2. This will result in the total allowable TNT equivalent explosive weight for the shot. The TNT equivalent of munitions' fillers must be used in this calculation:

$$NEW_{INT} = [(MFD/328)^3]/1.2$$

If multiple types of ordnance are to be destroyed in one consolidated shot, the TNT equivalent of each item must be calculated as well as the TNT equivalent of each donor charge. Add all of the TNT equivalent weights together and calculate the K328 overpressure distance. The K328 distance will not exceed the maximum fragment distance of the MGFD. All consolidated shots will be performed per HNC document, Procedures for Demolition of Multiple Rounds (Consolidated Shots) on OE Sites, August 1998 with Technology Update March 2000.

3.5.9 Disposal Alternatives

No specific disposal alternatives are considered for this project. If situations arise that are beyond the capabilities of the contractor, CB&I will coordinate with USACE to request disposal assistance from military EOD.

3.6 INVESTIGATIVE-DERIVED WASTE PLAN

No hazardous waste is anticipated for this project. The general types of materials expected to be generated during the munitions response activities consist of MDAS and non-ordnance related scrap.

3.6.1 MDAS

Until the explosives safety status of accumulated items is determined through the dual inspection process, MPPEH is considered to potentially have an explosive hazard. This section describes storage, processing, certification, and documentation requirements for MDAS.

3.6.1.1 Storage

There has been no approved MPPEH storage area established; therefore, MPPEH will need to be inspected and certified as MDAS prior to leaving the work area. MDAS will not be commingled with MPPEH or MEC and will be stored in locked containers with signage and container seals traceable with the transfer documentation.

3.6.1.2 Processing

Processing includes collecting, consolidating, sorting, segregating, separating by metal type, inspecting, storing, decontaminating, transferring, certifying, releasing, demilitarizing (shredding, shearing, chopping, crushing, flattening, cutting, melting), and transporting materials.

In addition to the requirements for certification of having an explosives safety status of safe, MDAS will be demilitarized in accordance with DoD instruction 4160.21-M-1 (series).

MDAS may be released for further demilitarization (for example, mutilating, crushing, smelting) only if the integrity of the containers and the chain-of-custody is maintained, and the documents travel with the material through final disposition. The sealed containers will be shipped to a foundry and/or recycler for demilitarization or recycling where it will be processed through a smelter, shredder, or furnace prior to resale or release in accordance with all governing regulations. The facility will provide a return receipt indicating that the material has been received as well as a separate letter stating that the material has been destroyed by shredding or smelting, thus ensuring the proper chain-of-custody has been maintained.

3.6.1.3 Certifications and Requirements

The SUXOS and UXOSO are qualified and authorized to sign a certification of MDAS. Certification as safe by visual inspection requires a 100 percent inspection by one individual, followed by an independent 100 percent re-inspection by another.

Certification and/or verification of MDAS requires dual signatures on the transfer document. The first signature will be provided by either the SUXOS or the UXOSO. The second signature will be provided by the USACE OE Safety Specialist. Methods to ensure the veracity of the chain-of-custody will include numbering containers with unique identifiers, labeling containers with permanent, weatherproof markings or labels, and locking/sealing containers.

3.6.1.4 Documentation of MDAS Certification

Certification as MDAS will be provided using a Disposal Turn-in Document DD Form 1348-1 (series). The two signatures required for the safe certification must be directly above the typed or clearly stamped or legibly printed full name, rank/rate/grade, complete organization name and address, and phone numbers. Safe certifications shall include the following statement:

> *This certifies that the material potentially presenting an explosive hazard listed has been 100% properly inspected and to the best of our knowledge and belief, is inert and/or free of explosives or related "materials."*

3.6.1.5 Disposal

MDAS will be sent to a foundry and/or recycler for disposal. The integrity of the containers and the chain-of-custody will be maintained and the DD Form 1348-1 will travel with the material through final disposition. The material will be processed through a smelter, shredder, or furnace prior to resale or release in accordance with all governing regulations. The facility will provide a return receipt indicating that the material has been received as well as a separate letter stating that the material has been destroyed by shredding or smelting, thus ensuring the proper chain-of-custody has been maintained.

3.6.2 Non-Ordnance Related Scrap

Non-ordnance related scrap could be generated during intrusive investigations. Metal that is inspected and is not munitions-related will be removed from the site and stored separately from the MPPEH, MDAS, and MDEH. The metal will be recycled and or disposed through FTSW.

3.6.3 Investigation-Related Trash

Investigation generated trash such as used personal protective equipment, spent shock tube, miscellaneous packaging material, etc., will be disposed of as municipal waste.

3.6.4 Clearing and Grubbing

Minor brush that may interfere with RFI activities will be cut down and left in the vicinity of each work area as long as it does not accumulate.

3.7 RISK CHARACTERIZATION AND ANALYSIS

A baseline estimate of the hazard from MEC at FTSW was developed using the MRSPP, as discussed in Section 1.9. Further evaluation of MEC hazards will be necessary to complete the RFI and for use in the CMS to estimate hazard reduction for various response actions. The planned method for MEC hazard evaluation is the MEC HA (USEPA, 2008). The MEC HA allows a project team to evaluate the potential explosive hazard associated with an MRS, given current conditions and under various cleanup, land use activities, and land use control (LUC) alternatives. As the approach is standardized, it provides a method of hazard assessment that is more easily understood by, and communicated to, stakeholders. The MEC HA provides a quantitative hazard assessment for MRS sites by using direct analysis of site conditions and human issues that create MEC risk. The MEC HA will allow the alternatives to be qualitatively compared for the level of protectiveness.

If MC sampling is warranted and an MC release is discovered and delineated, a quantitative risk assessment will be completed for MC. Data collected during the Phase 2 CS will be used to supplement MC data collected during the RFI. Validated analytical data will be used for the risk assessment to determine the potential risk to human health and the environment using the GAEPD 1996 *Guidance for Selecting Media Remediation Levels at RCRA Solid Waste Management Units*.

With the GAEPD guidance for RCRA units established, the following description of the RFI risk assessment protocol is intentionally brief, focusing on variances from the aforementioned guidance because of site-specific conditions or updated risk assessment protocol. Most of the updates in risk assessment protocol and its application to site-specific conditions at Army facilities in Georgia are captured in the GAEPD-approved *Installation Baseline Risk Assessment Work Plan and Supporting Documents for Fort Benning, GA* (USACE, 2012). Fort Benning is a facility similar in many ways to FTSW, and the approved risk assessment protocol described in USACE (2012) reflects current GAEPD expectations. Therefore, the USACE (2012) guidance for Fort Benning was referenced for application to FTSW.

3.7.1 Protocol of the RFI Human Health Risk Assessment for MC

3.7.1.1 Relevant Receptor Scenarios

Data of interest are limited to the results of metals and explosive analysis of surface soil, subsurface soil, sediment, and surface water. Receptor scenarios to be evaluated and the pathways by which they are assumed to be exposed to these media are as follows:

Receptor/Medium	Complete Exposure Pathway
Maintenance Worker/Surface Soil	Incidental ingestion Dermal uptake Inhalation of fugitive dust
Groundskeeper/Surface Soil	Incidental ingestion Dermal uptake Inhalation of fugitive dust
Construction Worker/Surface Soil, Subsurface Soil, Total Soil	Incidental ingestion Dermal uptake Inhalation of fugitive dust and volatile organic compounds
Youth Trespasser/Surface Soil	Incidental ingestion Dermal uptake Inhalation of fugitive dust
Youth Trespasser/Sediment	Incidental ingestion
Youth Trespasser/Surface Water (Wading)	Incidental ingestion Dermal uptake
On-site Resident/Surface Soil	Incidental ingestion Dermal uptake Inhalation of fugitive dust

The only current residential land use is the military barracks in portions of Anti-Aircraft Range - 4A, which are in close proximity to Anti-Aircraft Range - 4B. It is generally Army policy not to evaluate residential exposure unless a site is currently used for residential purposes or will be used for residential purposes in the future. However, basing the risk-based screening step on residential site use, and if necessary including residential exposure in the quantitative risk assessment is helpful for the following reasons:

- To identifying the measures required to attain NFA status
- To provide the basis for establishing alternative corrective measures responses
- To determine whether residential land use should be restricted
- To provide the basis for performing a life-cycle analysis that permits comparing the costs of long-term application of LUCs with active corrective measures, which is helpful to determine whether there is a benefit to incrementally increasing the scope of corrective measures to include cleanup to residential standards so as to attain unrestricted land use

3.7.1.2 Data Evaluation

Separate data sets will be generated for each of the four MRSs included in this evaluation. Soil and subsurface soil will be evaluated separately in the risk assessment. That is, the receptor scenarios listed above will be evaluated twice—once assuming exposure to surface soil and once assuming exposure to subsurface soil. The construction worker, in addition to being evaluated for exposure to surface soil and to subsurface soil separately, will also be evaluated for exposure to total soil, a data set formed by combining the surface soil and subsurface soil analytical data before identifying COPCs and estimating EPCs. Analytical data from previous investigations will be combined with analytical data from the pending investigation (Section 3.1.3) unless it is clear that the analytical results from previous investigations do not reflect current site conditions.

The initial function of data evaluation is identification of chemicals of potential concern (COPCs), which is accomplished in two steps. The first step is screening of inorganic chemicals against facility-specific background screening values. Background data currently are available only for soils; additional sampling will be done to obtain background data sets for surface water and sediment. This initial background screening step involves comparing the maximum detected concentrations (MDCs) of the detected metals with their 95th upper tolerance limits (UTLs) on the background data set. Metals with MDCs that do not exceed their 95th UTLs are excluded from further consideration. Metals with MDCs that exceed their 95th UTLs are subjected to the second step.

The second step of COPC identification is risk-based screening to exclude from further evaluation those chemicals unlikely to contribute significantly to unacceptable risk. For the reasons described above, the risk-based screening step for soils and sediment will utilize risk-based screening concentrations derived from residential RSLs, which are more conservative than industrial RSLs. For any given chemical, the risk-based screening concentration will be the smaller of:

- The RSL based on a cancer risk of 1E-6
- The RSL based on a noncancer Hazard Quotient (HQ) of 0.1

The edition of the RSLs current when the project is begun will be used throughout all versions of the RFI and (if necessary) the following corrective measures implementation work plans, corrective action programs, and confirmation follow-up. This two-step screening procedure will be applied to identify COPCs separately for surface soil and subsurface soil individually for each of the four MRSs. In addition for the third construction worker evaluation, the surface and subsurface soil data sets will be combined before identifying COPCs.

Risk-based screening values for surface water will be taken from the most recent version of the USEPA ambient water quality criteria based on consumption of drinking water and aquatic organisms. The most recent tap water RSLs based on a cancer risk of 1E-6 or an HI of 0.1 will be used for chemicals without ambient water quality criteria.

The second function of data evaluation is estimation of exposure point concentration (EPC). Separate EPCs will be estimated for COPCs identified in surface soil, subsurface soil, total soil, sediment, and surface water for each of the four MRSs using the USEPA method explained below.

EPCs will be estimated as the 95 percent upper confidence limit (UCL) on the arithmetic mean. The USEPA ProUCL Version 5.0.0 software will be used to estimate UCLs, provided that analytical data are available for at least 10 samples; otherwise, the maximum detected concentration (MDC) will be adopted as the EPC. The full reporting limit (RL) will be adopted as the surrogate concentration for non-detects to complete the data set, except that non-detects with RLs greater than two times the MDC are not included in the data set (USEPA, 1989).

3.7.1.3 Exposure Assessment

Relevant receptor scenarios under the current site use assumption include maintenance workers, groundskeepers, and construction workers. Adult and child residents will be included as potential future receptors in the assessment because these receptors represent the upper bound on exposure and risk and are necessary to define the LUCs that may be placed on the site. The youth trespasser will also be included as a very unlikely potential receptor. The relevant exposure pathways and variables for these receptor scenarios are detailed in **Table 3-9**. Most of the variable values, compiled by USACE (2012), are standard default values taken from various USEPA guidance documents up to 2004. Some of the values are revised to reflect the new USEPA (2014) directive, which updates some of the exposure variable values.

The use of an EPC is related to the exposure pathway for a particular medium. If a receptor's exposure pathway to a medium is direct (i.e., the receptor interacts directly with the medium, e.g., incidental ingestion of soil by hand-to-mouth activity), then the EPC is used as the concentration for estimating that exposure. If a receptor's exposure pathway to a medium is indirect (e.g., inhalation of airborne particulates [dust]), the EPC in soil is used as the starting point for calculating the EPC in the exposure medium (i.e., ambient air). Such estimates involve mathematical models and other methodology prescribed by USEPA and other regulatory agencies, as follows:

Exposure-Point Concentrations in Ambient Air

Exposure to airborne dust from soil is a potential exposure pathway for all receptor scenarios evaluated herein. USEPA (2002a) provides a particulate emission factor model that can be used to estimate the concentration of a chemical in air from dust as follows:

$$PEF = Q/C_{wind} \bullet \frac{3600}{0.036 \bullet (1 - V) \bullet (U_m / U_t)^3 \bullet F(x)} \qquad \text{Eq. 1}$$

where:

PEF	=	particulate emission factor (cubic meter per kilogram [m^3/kg], calculated)
Q/C_{wind}	=	inverse of the ratio of the geometric mean air concentration to the mission flux at center of square source (gram per square meter [g/m^2] - second per kilogram per cubic meter [kg/m^3], see below)
3600	=	seconds/hour
V	=	fraction of surface covered with vegetation (default 0.5, unitless)
U_m	=	mean annual wind speed (default 4.69 m/s)
U_t	=	equivalent threshold value of wind speed at 7 meters (default 11.32 m/s)
F(x)	=	function dependent on U_m/U_t (default 0.194)

Table 3-9
Variables Used to Estimate Potential Chemical Intakes and Contact Rates for Receptors
Four Military Munitions Response Program Sites
Fort Stewart, Georgia

Pathway Variable [a]	**Units**	**Maintenance Worker**	**Groundskeeper**	**Construction Worker**	**Youth Trespasser**	**On-Site Resident Adult**	**On-Site Resident Child**
General Parameters Used in Intake Models							
Exposure frequency - except as noted (EF)	days/year	250	39*	250	52	350	350
Exposure duration (ED)	years	25	25	1	10	20	6
Body weight (BW)	kilograms	80	80	80	45	80	15
Averaging time - noncancer (AT_n)	days	9125	9125	365	3650	10950	2190
Averaging time - cancer (AT_c)	days	25550	25550	25550	25550	25550	25550
Inhalation of Resuspended Dust and/or Volatiles from Soil							
Exposure time (ET_a)	hours/day	8	8	8	6	24	24
Incidental Ingestion of Soil							
Incidental ingestion rate (IR_{soil})	mg/day	100	100	330	200	100	200
Dermal Contact with Soil							
Body surface area exposed (SA_{soil})	cm^2	3470	3470	3470	4100	6032	2690
Soil-to-skin adherence factor (AF)	mg/cm^2	0.12	0.12	0.12	0.1	0.07	0.2
Incidental Ingestion of Sediment							
Incidental Ingestion rate (IR_{sed})	mg/day	NA	NA	NA	100	NA	NA
Incidental Ingestion of Surface Water							
Incidental Ingestion rate (IR_{sw})	L/hr	NA	NA	NA	0.01	NA	NA
Exposure time (ET_{sw})	hours/day	NA	NA	NA	2	NA	NA
Dermal Contact with Surface Water							
Body surface area exposed (SA_{sw})	cm^2	NA	NA	NA	4100	NA	NA
Exposure time (ET_{sw})	hours/day	NA	NA	NA	2	NA	NA

[a] Taken from Table 4-2 of USACE (2012) unless updated by EPA (2014).

* Assumes a groundskeeper performs landscaping tasks (i.e., lawn mowing, shrub clipping, etc) once a week during the spring, summer and fall (39 weeks).

U.S. Army Corps of Engineers (USACE), 2012, ***Installation Baseline Risk Assessment Work Plan and Supporting Documents,*** Fort Benning, Georgia, revised: May 2009, March 2010, February 2012, and August 2012.

U.S. Environmental Protection Agency (EPA), 2014, ***Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors***, OSWER Directive 9200.1-120, 6 February 2014, updated 24 February 2015, online at http://www.epa.gov/oswer/riskassessment/pdf/superfund-hh-exposure/OSWER-Directive-9200-1-120-ExposureFactors.pdf.

cm/hour - centimeters per hour
cm^2 - square centimeters
kg/day - kilograms per day
mg/cm^2 - milligrams per square centimeter
mg/day - milligrams per day
L/hr - liters per hour

Q/C_{wind} is estimated as follows:

$$Q/C_{wind} = A \bullet exp\left[\frac{(lnA_{site} - B)^2}{C}\right] \qquad \text{Eq. 2}$$

where:

Q/C_{wind}	=	inverse of the ratio of the geometric mean air concentration to the emission flux at center of square source (g/m^2-second per kg/m^3), calculated
A	=	empirically derived constant (14.8349)
A_{site}	=	areal extent of site or source
B	=	empirically derived constant (17.9259)
C	=	empirically derived constant (204.1516)

Values for the empirically derived constants reflect meteorological conditions for Atlanta, GA, from Appendix D of USEPA (2002a).

The USEPA (2002a) particulate emission factor model is based on the assumptions of an "unlimited reservoir" model and that the source area is square. USEPA (2002a) has determined that this pathway is generally insignificant for receptors other than the construction worker, compared with the incidental ingestion and dermal uptake exposure routes, except for the evaluation of cancer risk arising from airborne chromium. Therefore, this pathway will be evaluated for all COPCs in soil for the construction worker, but for the maintenance worker, groundskeeper, youth trespasser and on-site resident only for chromium identified as a COPC.

The concentration of a chemical in the air is calculated as follows:

$$C_a = \frac{C_s}{PEF} \qquad \text{Eq. 3}$$

where:

C_a	=	contaminant concentration in air (mg/m^3, calculated)
C_s	=	contaminant concentration in soil (mg/kg)
PEF	=	particulate emission factor (m^3/kg)

Estimating Exposure Route-Specific COPC Intakes

Incidental Ingestion of COPCs in Soil—The ingested dose of COPCs in soil for all receptors is estimated with the following equation:

$$I_{soil} = \frac{(C_{soil})(IR_{soil})(EF)(ED)(CF_1)}{(BW)(AT)} \qquad \text{Eq. 4}$$

where:

I_{soil}	=	ingested dose of COPC in soil (mg/kg-day, calculated)
C_{soil}	=	EPC of COPC in soil (mg/kg)
IR_{soil}	=	ingestion rate of soil (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
CF_1	=	conversion factor (1×10^{-6} kilogram per milligram)
BW	=	body weight (kg)
AT	=	averaging time (days)

The same equation is used to estimate the ingested dose of COPCs in sediment (I_{sed}) by the youth trespasser, except that C_{soil}, is replaced by the EPC of COPC in sediment (C_{sed}), and IR_{soil} is replaced by the incidental ingestion rate of sediment (IR_{sed}).

<u>Incidental Ingestion of COPCs in Surface Water</u>—The ingested dose of COPCs in surface water for the wading youth trespasser is estimated with the following equation:

$$I_{sw} = \frac{(C_{sw})(IR_{sw})(ET_{sw})(EF)(ED)}{(BW)(AT)} \qquad \text{Eq. 5}$$

where:

I_{sw}	=	ingested dose of COPC in surface water (mg/kg-day, calculated)
C_{sw}	=	EPC of COPC in surface water (mg/kg)
IR_{sw}	=	ingestion rate of surface water (mg/day)
ET_{sw}	=	exposure time (hours/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)

<u>Inhalation of COPCs in Ambient Air</u>—The cancer risk and noncancer hazard for inhalation exposure are calculated directly from the concentration of COPC in ambient air, which is done within the risk characterization section. Since no dose or contact (exposure) rate is calculated, no equation is required in this section.

<u>Dermal Absorption of COPCs from Soil and Surface Water</u>—Dermal absorption of COPCs from soil is a potentially complete exposure pathway for all receptors. Dermal absorption of COPCs from surface water is a potentially complete exposure pathway for the youth trespasser in a wading scenario. Unlike the methodology for estimating ingested dose of COPC, which quantifies the dose presented to the barrier membrane (the gastrointestinal mucosa), dermal dose is estimated as the dose that crosses the skin and is systemically absorbed. For this reason, dermal toxicity values are also based on absorbed dose. The absorbed dose of COPC is estimated from the following equation (USEPA, 2004):

$$DAD = \frac{(DA_{event})(EV)(SA)(EF)(ED)}{(BW)(AT)} \qquad \text{Eq. 6}$$

where:

DAD	=	average dermally absorbed dose of COPC (mg/kg-day, calculated)
DA_{event}	=	dose absorbed per unit body surface area per event (mg/cm^2-event, calculated)
EV	=	event frequency (events/day)
SA	=	surface area of the skin available for contact with soil or surface water (cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)

Separate equations are used to calculate the dermal dose absorbed from soil and from water. Dermal uptake of constituents from soil assumes that absorption is a function of the fraction of a dermally applied dose that is absorbed. It is calculated using the following equation (USEPA, 2004):

$$DA_{event} = (C_{soil})(AF)(ABS)(CF_1) \qquad \text{Eq. 7}$$

where:

DA_{event} = dose absorbed per unit body surface area per event (mg/cm^2-event, calculated)
C_{soil} = EPC of COPC in soil (mg/kg)
AF = soil-to-skin adherence factor (mg/cm^2-event)
ABS = absorption fraction (unitless, chemical-specific)
CF_1 = conversion factor (1 x 10^{-6} kilogram per milligram)

<u>Dermal Absorption of COPCs from Surface Water</u>—Dermal absorption of COPCs from surface water is a potentially complete exposure pathway for the youth trespasser in a wading scenario. DAD is calculated as described for Equation 6.

DA_{event} for inorganic chemicals in water is calculated from the following equation (USEPA, 2004):

$$DA_{event} = (C_{sw})(K_p)(ET_{sw})(CF_4) \qquad \text{Eq.8}$$

where:

DA_{event} = dose absorbed per unit body surface area per event (mg/cm^2-event, calculated)
C_{sw} = concentration of COC in surface water (milligrams per liter [mg/L])
K_p = permeability coefficient (centimeters per hour [cm/hour])
ET_{sw} = time of exposure (hours/day)
CF_4 = conversion factor (0.001 liters per cubic centimeter [L/cm^3])

It is assumed that wading involves intermittent exposure to surface water; therefore, for simplicity it is assumed that uptake of organic COPCs does not reach steady state, in which case the following equation is used (USEPA, 2004):

$$DA_{event} = 2(FA)(K_p)(C_{sw})(CF_5)\sqrt{\left(\frac{6\tau(ET_{sw})}{\pi}\right)} \qquad \text{Eq. 9}$$

where:

DA_{event} = dose absorbed per unit body surface area per event (mg/cm^2-event, calculated)
FA = fraction absorbed (dimensionless, chemical specific)
K_p = permeability coefficient (cm/hour, chemical specific)
C_{sw} = concentration of constituent in water (mg/L)
CF_5 = conversion factor (0.001 L/cm^3)
τ = lag time for contaminant to cross stratum corneum (hours/event, chemical specific)
ET_{sw} = exposure time (hours/day)

The dimensional integrity of Equations 6 through 9 is maintained by assuming one exposure event per day.

Dermal-from-soil absorption factors and chemical properties relevant to dermal uptake from water will be taken from the most recent RSL tables, which compile the available empirical data and application of USEPA (2004) guidance for those chemicals for which empirical data are not available.

3.7.1.4 Toxicity Assessment

The toxicity assessment consists largely of locating the toxicity values for the COPCs and exposure routes evaluated in the cumulative risk assessment. The most recent version of the RSL tables will be accessed as a regularly updated source of candidate toxicity values, which are then reviewed according to the guidance and hierarchy provided by USEPA (2003):

- USEPA's on-line Integrated Risk Information System (IRIS) database containing toxicity values that have undergone the most rigorous Agency review.
- Provisional peer-reviewed toxicity values (PPRTVs) for the Superfund Technical Support Center. Occasionally, PPRTVs are more recent than information on IRIS, simply because IRIS files have not yet been updated. When this is clearly the case, the PPRTVs are selected instead of those on IRIS.
- Health Effects Assessment Summary Tables, other USEPA documents or memoranda, various state values, minimal risk levels from Agency for Toxic Substances Disease Registry assessments (modified if necessary to reflect USEPA methodologies). Toxicity values from these sources will be evaluated according to USEPA guidance and precedent to identify the most reasonable and scientifically defensible for use in the evaluation.

Dermal toxicity values will be developed from the oral values by adjusting for gastrointestinal absorption, using the gastrointestinal absorption factors compiled in the most recent version of the RSL tables.

Target organ or critical effect will be used as a surrogate for mechanism of toxicity as described in USEPA (1989) to refine the assumption of additivity for estimation of noncancer HI in the cumulative risk assessment.

The compilation of toxicity values and other chemical-specific variable values in the version of the RSL tables current when the project is begun will serve as the initial source of candidate oral toxicity values for consideration. These will be evaluated in the light of site-specific conditions as per USEPA (2003) guidance and subsequent discussions to locate or develop the highest quality toxicity value to use in risk characterization. The rationale for selecting toxicity values that differ from those in the RSL tables will be thoroughly explained in the text. The toxicity values selected at the start of the project will be used until its completion.

Chronic exposure will be defined as an exposure duration that exceeds 6 years. Chronic toxicity values will be used to evaluate adverse noncancer health effects for all receptors, without making provision for the construction worker whose exposure duration is only 1 year (365 days), which is more appropriately classified as subchronic. However, subchronic toxicity values will be considered for refining the assessment of chemicals that "fail" the initial assessment for the construction worker.

3.7.1.5 Risk Characterization

Risk characterization combines the results of the exposure assessment and toxicity assessment to yield a quantitative expression of risk. This quantitative expression is the probability of developing cancer, or a non-probabilistic comparison of estimated dose rate or concentration with a reference dose or concentration for noncancer effects. Quantitative estimates will be developed for individual chemicals and exposure pathways for each receptor. Although some chemicals induce both cancer and noncancer effects, the risks for each endpoint are calculated separately.

Cancer Risk

The risk of cancer from exposure to potential chemical carcinogens will be estimated as the probability of an individual developing cancer over a lifetime, and is called the Individual Lifetime Cancer Risk (ILCR).

Oral and Dermal Cancer Risk

In the low-dose-rate range, which would be expected for most environmental exposures, ILCR will be estimated for a given chemical by the oral and dermal exposure routes from the following linear equation (USEPA, 1989):

$$ILCR = (CDI)(SF) \qquad \text{Eq. 10}$$

where:

ILCR = individual lifetime cancer risk, a unitless expression of the probability of developing cancer, adjusted for background incidence (unitless, calculated)
CDI = chronic daily intake, averaged over 70 years (mg/kg-day)
SF = oral or dermal cancer slope factor $(mg/kg\text{-}day)^{-1}$

The chronic daily intake term in Equation 10 is equivalent to the "I" or "DAD" terms (intake or contact rate) in Equations 4 through 6 when these equations are evaluated for cancer.

Inhalation Cancer Risk

ILCR for inhalation exposure will be calculated by the following equation, adapted from Equation 6 of USEPA (2009), as follows:

$$ILCR = \frac{(C_a)(CF_2)(URF)(ET_a)(EF)(ED)}{(24)(AT_c)} \qquad \text{Eq. 11}$$

where:

ILCR = individual lifetime cancer risk, a unitless expression of the probability of developing cancer, adjusted for background incidence (unitless, calculated)
C_a = EPC of COPC in air $(\mu g/m^3)$
CF_2 = conversion factor (1E3 µg/mg)
URF = inhalation cancer unit risk factor $(\mu g/m^3)^{-1}$
ET_a = time exposed to contaminated air (hours/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
24 = hours/day
AT_c = averaging time for cancer risk (days)

As a matter of policy, USEPA (1989, 2005) considers the cancer risk of simultaneous exposure to low dose rates of a chemical to be additive across exposure routes and across chemicals, regardless of the chemicals' mechanisms of toxicity or sites (organs of the body) of action. Total cancer risk resulting from simultaneous exposure to a given chemical by multiple routes will be estimated from the following equation (USEPA, 1989):

$$ILCR_T = ILCR_{R1} + ILCR_{R2} + ...ILCR_{Ri} \qquad \text{Eq. 12}$$

where:

$ILCR_T$ = total cancer risk for the given chemical in a given source medium summed across exposure routes (unitless, calculated)
$ILCR_{Ri}$ = cancer risk for the given chemical in a given source medium for exposure route i (unitless)

Cumulative risk summed across all chemicals and media will be estimated for a given receptor as follows:

$$ILCR_{Cum} = ILCR_{T1} + ILCR_{T2} + ...ILCR_{Ti} \qquad \text{Eq. 13}$$

where:

$ILCR_{Cum}$ = cumulative cancer risk for a given receptor summed across chemicals and source media (unitless, calculate)
$ILCR_{(Ti)}$ = total cancer risk for chemical i in a given source medium summed across exposure routes (unitless)

The USEPA NCP [40 CFR §300.430(3)(B) and (C)] identifies 1E-6 as a level at or below which cancer risk is considered to be minimal. Levels from 1E-6 to 1E-4 represent a risk management range within which cancer risks may or may not be subjected to further action. Cancer risk levels above 1E-4 are generally considered to be unacceptable and require further action. GAEPD considers a cancer risk of 1E-6 as the trigger level at which further action may be required.

Noncancer Effects

The hazards associated with the noncancer effects of chemicals will be evaluated by comparing an exposure route-specific intake or contact rate or concentration with a reference dose (RfD) or reference concentration (RfC). The HQ, defined as the ratio of intake (or concentration) to the RfD (or RfC), will be estimated for a given chemical by the oral and dermal exposure routes from the following equation (USEPA, 1989):

$$HQ = I / RfD \qquad \text{Eq. 14}$$

where:

HQ = hazard quotient (unitless, calculated)
I = intake rate of chemical averaged over exposure duration (mg/kg-day)
RfD = reference dose (mg/kg-day)

The “I” term in Equation 14 is equivalent to the “I” or “DAD” terms (intake or contact rate) in Equations 4 through 6 when these equations are evaluated for noncancer.

HQ for inhalation exposure will be calculated by the following equation, adapted from Equation 8 of USEPA (2009), as follows:

$$HQ = \frac{(C_a)(ET_a)(EF)(ED)}{(RfC)(24)(AT_n)} \qquad \text{Eq. 15}$$

where:

HQ = hazard quotient (unitless, calculated)
C_a = EPC of COPC in air (µg/m^3)
ET_a = time exposed to contaminated air (hours/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
RfC = inhalation reference concentration (mg/m^3)
24 = hours/day
AT_n = averaging time for noncancer hazard (days)

The approach for noncancer hazard evaluation is different from the probabilistic approach used to evaluate carcinogenic risks. For example, an HQ of 0.01 does not imply a 1 in 100 chance of an adverse effect, but indicates that the estimated intake rate is 100 times lower than the RfD (or RfC). An HQ of 1.0 indicates that the estimated intake equals the RfD (or RfC).

In the case of simultaneous exposure of a receptor to a given chemical by multiple exposure routes, a total HI for the chemical of interest will be calculated as the sum of the route-specific HQs by:

$$HI = HQ_{R1} + HQ_{R2} + \ldots HQ_{Ri} \qquad \text{Eq. 16}$$

where:

HI = hazard index for a given chemical summed across exposure routes and source media (unitless, calculated)
HQ_{Ri} = hazard quotient for the given chemical for exposure route *i* (unitless)

HI values will be summed across chemicals and media to estimate a cumulative HI for the receptor:

$$HI_{Cum} = HI_1 + HI_2 + \ldots HI_i \qquad \text{Eq. 17}$$

where:

HI_{Cum} = Cumulative hazard index summed across chemicals and source media (unitless, calculated)
HQ_i = hazard quotient for a given chemical summed across exposure routes and source media (unitless)

If the HI for a given receptor exceeds the threshold level of 1, individual HI values may be calculated for each target organ, as described by USEPA (1989). This is called a 'target organ evaluation.' Total HI for a given target organ will be calculated for a given receptor as described in the following equation:

$$HI_{TO} = HQ_{COPC1} + HQ_{COPC2} + \ldots HQ_{COPCi} \qquad \text{Eq. 18}$$

where:

HI_{TO} = total hazard index for a given target organ for a given receptor (unitless, calculated)
HQ_{COPCi} = hazard quotient for the target organ of interest estimated for the i^{th} COPC (unitless)

HI estimates at or below the threshold value of 1 are interpreted to mean that adverse noncancer effects are unlikely (USEPA, 1989).

It should be noted that the HQ terms summed in Equation 18 include all those associated with the target organ of interest, regardless of exposure routes for which they were calculated. It is possible that the same chemical would occur multiple times in a given target organ HI calculation, particularly if it is relevant to more than one route of exposure. Furthermore, the target organ for dermal exposure is assumed to be the same as oral exposure, in which case the HI for a given target organ would include HQs calculated for oral and dermal exposure to the relevant chemicals.

3.7.1.6 Identifying Chemicals of Concern

USEPA (2002b) defines COCs as COPCs that contribute significantly to cumulative ILCR that exceeds the trigger level of 1E-4, or that contribute significantly to total HI for a given target organ that exceeds the threshold level of 1. Significant contribution to cancer risk means that the total ILCR summed across relevant exposure pathways for a given COPC in a given source medium exceeds 1E-6. Significant contribution to noncancer hazard means that the total HI summed across relevant exposure pathways for a given COPC in a given medium, or across relevant exposure pathways and source media for a given target organ, exceeds 0.1. In accordance with GAEPD requirements, a cumulative ILCR of

1E-6, two orders of magnitude more restrictive than the USEPA (2002b) value, will be used as the trigger level for identifying cancer-based COCs.

Refining COCs

Metals COPCs initially identified as COCs may be subjected to further background evaluation. These further background evaluations may include the use of statistical tests as provided in USEPA's ProUCL statistical software, such as Gehans and Quantile tests. If metals are identified above background, further background comparison techniques, such as geochemical evaluations, will be employed. Metals shown thereby to be present as naturally occurring background will not identified as COCs or subjected to RL estimation, and will require NFA.

GAEPD (1996) requires the estimation of receptor- and medium-specific remediation levels for each chemical identified as a COC. However, GAEPD guidance explicitly states that the assessment should present remediation levels for individual COCs based on a specific cancer risk or HI level – not on a range of risk or hazard levels as specified by the EPA remedial goal option methodology. GAEPD (1996) also states, "In no event shall a facility propose a remediation level that exceeds a risk level of 1E-4 for carcinogens or an HQ of 3 for non-carcinogens." While GAEPD (1996) prefers remediation levels based on a cancer risk of 1E-6 or an HI of 1, they may accept less restrictive remediation levels that do not exceed a cancer risk of 1E-4 or an HI of 3. The exact cancer risk and HI values on which to base the remediation levels will depend on the number and nature of the COCs identified by the assessment.

Remediation levels for cancer-based COCs for a given receptor, site, and medium are calculated by the following equation (USEPA, 2002b):

$$RL = \frac{EPC \bullet TR}{ILCR} \qquad \text{Eq. 19}$$

where:

RL = remediation level for a given COC, receptor, and source medium (calculated, mg/kg)
EPC = exposure point concentration of the COC in the given medium (mg/kg)
TR = target risk level (1E-6, but see discussion above)
ILCR = total individual lifetime cancer risk for the COC, for a given receptor added across all exposure routes for a given source medium

Remediation levels for noncancer-based COCs are estimated as follows:

$$RL = \frac{EPC \quad THI}{HI} \qquad \text{Eq. 20}$$

where:

RL = remediation level for a given COC, receptor, and source medium (calculated, mg/kg)
EPC = exposure point concentration of the COC in the given medium (mg/kg)
THI = target hazard index (0.1, but see discussion above)
HI = total hazard index for a given COC, for a given receptor added across all exposure routes for a given source medium

3.7.1.7 Protection of Groundwater

GAEPD considers all groundwater to be a potentially potable source; therefore, the potential for leaching to impact groundwater quality will be evaluated as a two-step screening procedure. Step 1 involves comparing detected concentrations with their background screening values to eliminate from further consideration those metals present in soil at naturally occurring concentrations. Step 2 involves comparing detected concentrations with soil screening levels (SSLs) for groundwater protection. To ensure that the SSLs reflect current groundwater standards and toxicity values, the SSLs in the most recent USEPA RSL tables will be used as the basis for their development. The target leachate concentration will be the maximum contaminant level (MCL) based SSL, if available. If there is no MCL, then the tap water risk-based SSL will be used. Should a chemical exceed the SSL, an appropriate dilution-attenuation factor will be developed and used in accordance with USEPA guidance.

The two-step screening procedure is a very conservative approach intended to remove from further consideration only those chemicals that could not impact groundwater quality. Chemicals that 'fail' the two-step screen will be subjected to additional refinement to clarify their potential to degrade groundwater quality by leaching. Refinement for metals may include clarifying their background status as mentioned above. Other refinement may include evaluating the uncertainty and conservatisms built into the USEPA (2002a) SSL leaching model.

3.7.2 Protocol of the RFI Screening Level Risk Assessment

The potential for ecological risks from exposures to contaminants detected at the MRSs will be assessed through the completion of a screening level ecological risk assessment (SLERA). The SLERA will be conducted in accordance with the guidelines set forth in *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (USEPA, 1997), *Guidelines for Ecological Risk Assessment* (USEPA, 1998), *Risk Assessment Handbook, Volume II: Environmental Evaluation* (USACE, 1996), and Tri-Service Procedural Guidelines for Ecological Risk Assessment (USAEC, 2000).

Based on information provided in *Environmental Assessment, Integrated Natural Resources Management Plan, Fort Stewart/Hunter Army Airfield* (FTSW, 2005), there are four types of ecosystems at FTSW: sandhills, pine flatwoods, upland forests, and wetlands. Preliminary information suggests that the MRSs currently under investigation are located in pine flatwoods. Based on a 1995 Nature Conservancy inventory, the following numbers of species were identified as threatened, endangered, species of concern, or rare:

- Plants—nine species
- Insects—one species
- Birds—eight species
- Reptiles—four species
- Amphibians—three species
- Fish—one species

Whether or not any of these species are present, or likely to be present at the MRSs under investigation will be further researched during preparation of the SLERAs. Based on current information related to a lack of aquatic habitat at any of the MRSs under investigation, no fish species are present.

The SLERA will consist of the following components:

- Description of the environmental setting at the MRSs.
- Discussion of the constituents detected in site soils. For purposes of the SLERAs, ecological exposure to chemicals detected in surface soils (0–1 foot bgs) will be considered, as well as chemicals detected in subsurface soils (1–5 feet bgs). Combined surface and subsurface soil exposures would be more relevant for burrowing wildlife.
- Presentation of the soil ESVs used to select chemicals of potential ecological concern (COPECs) for the SLERA, such as USEPA Ecological SSLs.
- Description of the ecotoxicity of the constituents selected as COPECs at the MRSs.
- Discussion of the potential ecological receptors at the MRSs.
- Description of the complete exposure pathways at the MRSs.
- Discussion of the ecological assessment and measurement endpoints.

- Description of the EPCs of the different constituents in soil at each of the MRSs. EPC calculations will follow the same approach as previously discussed for the human health risk assessment.
- Calculation of screening level HQs for each constituent detected in MRS soils and selected as COPECs. HQs will be estimated for up to six terrestrial wildlife receptors, including an appropriate mix of mammalian and avian species, including herbivores, omnivores, and/or carnivores. In addition, direct-contact toxicity HQs for terrestrial plants and soil invertebrates will be estimated.
- Use of additional lines of evidence to refine the HQ estimates, such as more realistic estimates of chemical bioaccumulation, bioavailability, exposure, area use factor, and/or toxicity, typically referred to as Step 3 of USEPA (1997) 8-step ecological risk assessment (ERA) process.
- Identification of ecological COCs in MRS soils, as appropriate.
- Uncertainty analysis.
- SLERA summary and conclusions.

Based on the physical separation of each of the separate MRSs being investigated, separate SLERAs for each site are likely. However, depending on the constituents detected at the MRSs and the ecological habitat available at each site, it may be appropriate to combine two or more of the sites into one exposure unit. Therefore, individual MRSs may be grouped together for the purposes of conducting the SLERAs based on similar constituents and/or similar ecological habitat. The results of the SLERA(s) will provide sufficient information for risk managers to make a decision of either negligible ecological risk at the MRS (no further ERA is necessary) or further ERA (baseline ERA) is warranted. Alternatively, if SLERA hazards are determined to be unacceptable and the cost of remediation is estimated to be less than the cost of further ERA (e.g., a baseline ERA), then remediation may be recommended.

A baseline ERA will only be recommended for MRSs where the following three conditions are met:

- Ample habitat exists wherein ecological receptors can occur
- Contaminants are present in environmental media at levels that could pose unacceptable ecological hazard
- A complete exposure pathway exists whereby ecological receptors could be exposed to the chemical contaminants

If any one of these conditions is not met, then the potential for ecological receptors to be exposed to contaminants at levels that may pose an unacceptable hazard does not exist, and NFA is necessary to address ecological concerns. Determining whether contaminants are present at levels that could pose an unacceptable hazard will be accomplished through the SLERA. For MRSs where these conditions are met, a baseline ERA might be recommended.

The objective of a baseline ERA would be to evaluate the potential for adverse effects to ecological receptors from site contaminants. The potential for adverse effects to ecological receptors is dependent on the ecological receptor species, the contaminants present, and the pathways by which ecological receptors could be exposed to the contaminants. Since the nature and extent of contamination is unknown at this time, it would be premature to develop a plan to evaluate eco-receptors. Upon completion of the SLERA, a work plan will be developed for a baseline ERA at the FTSW MRSs if deemed necessary. The work plan would modify the preliminary ecological CSM, identify the assessment endpoints, the hypotheses being tested and the measurement endpoints selected for evaluation in the baseline ERA.

4.0 QUALITY CONTROL PLAN

This QCP identifies the QC approach and operational procedures to be employed by CB&I during project activities. This work plan was developed in accordance with DID MR-005-11.01 and the specifications of this RFI work plan.

The objectives of this QCP are to address the specific operating needs of the project and to establish the necessary levels of management and control to ensure all work performed meets the technical requirements of the applicable project plans and conforms in all respects to the requirements of the contract and applicable regulations. Specifically, this QCP addresses DQCRs; QC Inspection Process; QC Audits; Corrective/Preventive Action Procedures; Lessons Learned; Submittal Review and Document Change Procedures; and Qualifications and Training.

4.1 DAILY QC REPORTS

For all field work days, the UXOQCS is responsible for preparing and submitting the DQCR to the USACE OE Safety Specialist and the project file. The DQCR is to provide an overview of QC activities performed each day, including those performed for subcontractor and supplier activities. The QC reports are to present an accurate and complete picture of QC activities. They are to report both conforming and deficient conditions, and should be precise, factual, legible, and objective. Copies of supporting documentation, such as checklists and surveillance reports will be attached.

Each DQCR is to be assigned and tracked by a unique number comprised of the Delivery Order number followed by the date expressed as DDMMYY. Copies of DQCRs with attachments are to be maintained in the project file. An example DQCR is provided in **Appendix D**.

4.2 QC INSPECTIONS

The QC staff will be responsible for assisting the CB&I PM in maintaining compliance with this QCP through the implementation of a three-phase inspection process. This section specifies the minimum requirements that must be met and to what extent QC monitoring must be conducted by the QC staff. The inspection system is based on the three-phase system of control to cover the activities. The three-phase inspection system consists of preparatory, initial, and follow-up inspections for applicable definable features of work (DFWs). The three-phase inspection system will be performed on all proposed work sequences.

A DFW is defined as a major work element that must be performed to execute and complete the project. It consists of an activity or task that is separate and distinct from other activities and requires separate control. The DFWs for this project are summarized in **Table 4-1** along with reference to the pertinent work plan section. Inspection criteria for these DFWs will depend on the work tasks being performed. Procedures for conducting these DFWs are provided in this work plan, which may include specific QC procedures and tests that are integral to the work, such as equipment calibration and testing. This QCP does not attempt to reiterate these procedures. The QC staff will refer to the applicable portion of this work plan for specific QC requirements to be checked during QC inspections.

Table 4-1
Definable Features of Work

Feature No.	Definable Feature Of Work	Work Document Reference
1	Surface Reconnaissance	Work Plan, Section 3.2.1.1
2	Analog Geophysical Survey	Work Plan, Section 3.3.2
3	DGM Survey	Work Plan, Section 3.3.3
4	Intrusive Investigation	Work Plan, Sections 3.5
5	MEC Disposal by Detonation	Work Plan, Section 3.5.8
6	MPPEH Handling, Storage, and Demilitarization	Work Plan, Section 3.6.1
7	Environmental MC Sampling	Sampling and Analysis Plan

4.2.1 Preparatory Phase Inspection

A preparatory phase inspection will be performed prior to beginning each DFW. The purposes are to review applicable work plans, processes, and specifications and verify that the necessary resources, conditions, and controls are in place and compliant before the start of work activities. The QC staff shall verify that lessons learned during similar previous work have been incorporated as appropriate into the project procedures to prevent recurrence of past problems. The QC staff shall generate and use a Preparatory Phase Inspection Checklist. The generic checklist provided in **Appendix D** may be customized to address the specific DFW, work scope, and site conditions. Work plans and operating procedures are to be reviewed by the QC staff to ensure that prequalifying requirements or conditions, equipment and materials, appropriate work sequences, methodology, hold/witness points, and QC provisions are adequately described. The QC staff shall verify, as applicable, the following:

- The required plans and procedures have been prepared and approved and are available to the field staff
- Field equipment and materials meet required specifications
- Field equipment is appropriate for intended use, available, functional, and calibrated
- Work responsibilities have been assigned and communicated
- Field staff possesses the necessary qualifications, knowledge, expertise, and information to perform their jobs
- Arrangements for support services (such as on-site testing and off-site test laboratories) have been made
- Prerequisite site work has been completed

Discrepancies between existing conditions and approved plans/procedures are to be resolved prior to completing work. Corrective actions for unsatisfactory and nonconforming conditions identified during a preparatory inspection are to be verified by the QC staff prior to granting approval to begin work.

Client notification will be performed at least 48 hours prior to conducting preparatory phase inspections. Results are to be documented in the Preparatory Phase Inspection Checklist and summarized in the DQCR (see **Appendix D**).

4.2.2 Initial Phase Inspection

An initial phase inspection will be performed, as applicable, the first time each DFW is performed. The purposes will be to check preliminary work for compliance with procedures and specifications, to establish the acceptable level of workmanship, and to check for omissions and resolve differences of interpretation. The QC staff shall generate and use an initial inspection checklist. The Initial Phase Inspection Checklist form provided in **Appendix D** may be customized to address the specific work scope and site conditions. The QC staff will be responsible to ensure that discrepancies between site practices and approved specifications are identified and resolved. The QC staff will oversee, observe, and inspect all applicable DFWs at the project site and ensure that off-site activities, such as analytical testing, are properly controlled. Discrepancies between site practices and approved plans/procedures are to be resolved and corrective actions for unsatisfactory and nonconforming conditions or practices are to be verified by the UXOQCS or designee before granting approval to proceed. Client notification for initial inspections will be required at least 48 hours in advance. Results of initial inspections are to be documented in the initial phase inspection checklist and summarized in the DQCR.

4.2.3 Follow-Up Phase Inspection

Follow-up phase inspections will be performed periodically while the DFW is performed in order to ensure continuous compliance and level of workmanship. The QC staff will be responsible to monitor on-site practices and operations taking place, verify continued compliance of the specifications and requirements within the contract, site work scope, and applicable approved project plans and procedures. Discrepancies between site practices and approved plans/procedures will be resolved, and corrective actions for unsatisfactory and nonconforming conditions or practices must be verified by the QC staff prior to granting approval to continue work. Follow-up inspection results will be summarized in the DQCR.

Periodic checks of procedures and/or documentation will be made for completeness, accuracy, and consistency. Follow-up inspections of field activity will typically include a review of field data and any calibration logs for all instruments in use.

4.2.4 Transect/Grid Inspections

The UXOQCS will inspect each transect or grid to determine whether or not all anomalies have been detected and resolved in accordance with performance requirements. The UXOQCS will select a portion of each transect or grid equivalent to at least 2 percent of the area for QC testing. The UXOQCS will re-sweep the area and may select additional anomalies for QC excavation. For any transect or grid that fails a QC test, the transect or grid will be completely reworked. The definition of a failure is finding a metallic item of similar size to the smallest item in the instrument verification strip.

4.3 QC TESTING

QC testing is to be performed as an ongoing check to verify that investigations are meeting the performance metrics established for the project. QC testing will consist of coverage seeds and blind seeds that need to be recovered by the UXO team. It should be noted that on transects where the lane is only defined by regularly spaced control points, the UXO team may take a slightly different path than where the seeds are placed. Therefore, seeds will only be placed on portions of transects near control points where the lane is well defined.

If the seeded item is not detected, a Nonconformance Report will be issued and a causal analysis/corrective action will be developed.

4.3.1 Coverage Seeds

Coverage seeds are small pieces of metal (16-penny nails painted blue) that are easy to detect, placed within sweep lanes to ensure the entire lane has been swept. Coverage seeds will be placed at a rate of three per transect/grid per operator. If a coverage seed is not found, the transect or grid will be completely reworked.

4.3.2 Blind Seeds

Blind seeds are intended to verify that MEC of the type expected at the site are being adequately detected and recovered. Blind seeds will consist of simulated items of concern. Ongoing testing will consist of blind seeds placed within sweep lanes at a rate of one large/deep and one small/shallow per transect/grid per operator. A large/deep blind seed is defined as a large ISO oriented vertically at 3 feet below grade measured to the center of the item. A small/shallow blind seed is defined as a small ISO oriented vertically at 1 foot below grade measured to the center of the item. The seeded items will be painted blue and the exact location will be recorded to ensure it will be recovered in the event of a QC failure.

4.4 QUALITY AUDITS

Due to the importance of quality in this project, it is anticipated that at least one on-site audit will be conducted by the PM or QC Manager. Quality audits may be conducted at the discretion of the QC Manager. Audits are a formal assessment tool to determine the degree of conformance with project and external requirements. Audits of various project functions will be performed by the QC Manager, the QC staff, and may also be performed by USACE. These functions include, but are not limited to, explosive inventory, site documentation, scheduled reports, MEC/MDAS accountability, site reconnaissance, MC sampling, and administrative support activities. An audit report will be generated for every quality audit. Audit reports are typically a rich source of feedback information.

4.5 CORRECTIVE/PREVENTIVE ACTION PROCEDURES

Regular inspections, as specified in Section 4.2, should prevent deviations from the work plans and methods being used to perform quality work. However, this is not always the case. When unplanned deviations are detected that may affect the quality of the work performed, a nonconformance will be reported. If a change is discovered prior to beginning work, it will be documented as a variance.

4.5.1 Nonconformance Documentation

Complex field investigation, sampling, and analysis tasks such as those performed routinely as part of the RFI are sometimes subject to non-conformances. A nonconformance is defined as an unplanned deviation that occurs during the implementation of a task that cannot usually be corrected until after it has occurred. Nonconformances may include using unapproved methods, not following procedures, or substituting unapproved materials or equipment to perform an activity. All non-conformances must go through a cycle of being identified, documented, assessed, corrected, and will be reported. Each of these steps is critical in handling non-conformances as they are encountered.

The identification of a nonconformance is the responsibility of every person assigned to support the project. This responsibility is incorporated into each person’s understanding of the tasks assigned by the supervisor or task leader and the individual’s function on the project. As personnel perform their duties on the project, they must constantly be aware of the scope of the activity and recognize when a deviation from the planned activity has occurred or is occurring. After recognizing deviations, they must take action by informing their supervisors or site leaders and documenting in writing the specifics of what occurred using a nonconformance report. An example Nonconformance Report form is included in **Appendix D**. When completed, the nonconformance report will be reviewed by a peer or supervisor and presented to the PM. The PM will assign a lead individual who will work with the person who identified the nonconformance (and other team members as needed) to assess its impact on the project and develop a corrective action plan.

As warranted by the nonconformance, the USACE PM and/or appropriate technical support person will be contacted by the CB&I PM and asked to provide input into the assessment and corrective action process. In all cases, the CB&I PM will be consulted and the corrective action will be decided upon and recorded on the nonconformance report. Once the corrective action is implemented, the CB&I PM will assign a person to verify that the corrective action is successful in preventing future occurrences of the nonconformance. When this has been verified, the nonconformance report will be completed, and copies will be distributed to all individuals who participated in the identification, assessment, and resolution of the nonconformance. The completed report will be included as a permanent part of the project file. In addition, full documentation will be provided to USACE detailing what failed the quality assurance process, why it failed, and how the problem was corrected.

Before the next annual revision of the QCP, documented non-conformances will be reviewed and appropriate resolutions incorporated into the revised document. Additionally, work plan changes are discussed in Section 4.7.2. Any revisions will require the same level of approval as the original plan; revisions require approval by the PDT. Nonconformances will also be used by project auditors to help focus audits on the historical project deviations. The auditors will review the corrective action procedures established from the resolution of the non-conformances and determine whether the original nonconformance issues have been permanently resolved. Modified corrective actions may be indicated by the findings of the audit.

4.5.2 Continual Improvement

Project staff at all levels are to be encouraged to provide recommendations for improvements in established work processes and techniques. The intent is to identify activities that are compliant but can be performed in a more efficient or cost-effective manner.

Typical quality improvement recommendations include the identification of an existing practice that should be improved (e.g., a bottleneck in production) and/or recommendations for an alternative practice that provides a benefit without compromising prescribed standards of quality. Project staff members are to bring their recommendations to the attention of project management or QC staff through verbal or written means.

Deviations from established protocols are not to be implemented without prior written approval of the PM. Staff-initiated recommendations resulting in tangible benefits to the project should be formally acknowledged by project management personnel.

4.6 LESSONS LEARNED

Lessons learned on the project will be captured and reported on QC documentation forms (Section 4.2) and DQCRs (Section 4.1). Significant lessons learned will be highlighted, as applicable, in the monthly status reports.

4.7 SUBMITTAL MANAGEMENT

The PM will be responsible for overall management and control of project submittals, including submittal scheduling and tracking. The PM will be responsible for ensuring, through detailed review, that submittals, as well as the materials and work these represent, are in full compliance with applicable contract specifications. The PM will also be responsible for ensuring that a project file is established and maintained and that accurate project documents are retained and controlled as prescribed herein.

4.7.1 Submittal Reviews

Prior to client delivery or use, project submittals are to be reviewed and approved by CB&I per CB&I procedure T-DB-001(b). Knowledgeable members of the project staff and the PM or designated representative will conduct technical reviews for the project planning documents and report(s). Multiple reviewers will be used to evaluate different components of the documents (i.e., technical, editorial, and QC reviews). The reviewers will ensure that the planning documents and report(s) meet the following requirements:

- The documents satisfy the requirements of the SOW, requirements and DQOs identified, client requirements (including applicable DIDs), and applicable regulatory requirements
- Report assumptions are clearly stated, justified, and documented
- The reports clearly and accurately present the site investigation results
- The basis for the recommendations and conclusions presented in the reports are clearly documented
- The tables and figures are prepared and checked according to CB&I requirements
- The documents have been proofread; punctuation, grammar, and spelling are correct

Submitted documents may also contain signature locations for PM and other approval. Original Manuscript Routing Sheets, external reviewer comments, and comment resolution records will be retained in the project file, traceable to the deliverable, for recordkeeping purposes and future reference.

4.7.2 Work Plan Changes

The distribution of this work plan will be controlled by the PM in order to ensure that the most recent, accepted version is available at all locations where investigative activities covered by this work plan are performed. Revisions to this work plan will require the same level of approval, control, and distribution as the original. Revisions will be documented in the footer of each page and personnel will be informed of changes.

4.8 QUALIFICATIONS AND TRAINING

Project staff will be qualified to perform their assigned tasks in accordance with terms outlined by the contract. Resumes are included in **Appendix F**. UXO personnel will meet the minimum qualification standards commensurate with their duties, in accordance with DDESB TP-18 (DDESB, 2004). The UXOQCS will conduct and document all site-specific training and maintain records documenting the required qualifications and training for each site worker. The UXOQCS will monitor expiration dates in order to advise employees of the need for refresher training or other requirements and will maintain training records for personnel and visitors, as required by this work plan. All required records will be maintained on site for audit purposes. Field Activity Daily Logs will be maintained by the UXOQCS to document details of field activities during QC monitoring activities.

4.9 CHEMICAL DATA QUALITY MANAGEMENT PLAN

The UFP-QAPP is included as **Appendix H**, and presents a detailed discussion of chemical data quality.

5.0 EXPLOSIVES MANAGEMENT PLAN

This Explosives Management Plan provides details for the management of explosives during the RFI. This work plan was developed in accordance with DID MR-005-03 (Appendix K), Federal Acquisition Regulation 45.5, Bureau of Alcohol, Tobacco, and Firearms (ATF) P 5400.7 (ATF, 2000), DoD 6055.9-STD (DoD, 2009), and Army Regulation 190-11 (Army, 1998).

5.1 ACQUISITION

CB&I will acquire commercial explosives from a local ATF-licensed vendor or vendors who will deliver the materials to the project site. A copy of the CB&I user permit will be maintained at the project site, and upon request, will be made available to any local, state, or federal authority.

Types of explosives planned for use during this project for disposal of MPPEH and MEC or venting of inert munitions include:

- 32-gram perforators will be used to expose internal cavities and/or detonate the MPPEH and MEC.
- Detonating cord will be used to construct mainline-branch line shots where items are close together.
- Cast boosters (e.g., 1-pound pentolite booster or ¼-pound TNT) will be used for certain disposal situations.
- NONEL® shock tubing with a nonelectric blasting cap will be used to initiate the explosives. NONEL® detonators will be attached to NONEL® shock tubing and will be used in firing train to initiate the explosive reaction.

Maximum anticipated quantities of explosives that will be ordered and delivered to the site will depend on the number of items encountered.

5.2 INITIAL RECEIPT

The licensed explosives vendor will deliver the explosives to CB&I personnel at a designated location near the point of use. The actual type and quantity of explosives received will be noted on the shipping documentation with the signatures of both the delivery driver and the individual authorized to receive such explosives. When required to perform demolition procedures, required explosives will be ordered and delivered to the CB&I SUXOS. Only the SUXOS and UXOSO will be authorized to receive the explosives.

5.3 STORAGE

Explosives will be delivered but not be stored during the project. All demolition activities will be scheduled for a single day, with all of the required explosives being delivered and consumed on the same day. CB&I will coordinate with the explosive delivery driver so the driver will stay on site and unused explosives will be returned. Alternatively, the UXO team will perform a second cleanup shot to expend unused explosives.

5.4 TRANSPORTATION

This section presents the vehicle requirements and on-site transportation procedures for explosives during the FTSW RFI.

5.4.1 On-Site Transportation Procedures

Explosives will be delivered to the project by a licensed and permitted commercial explosives vendor. When explosives are required at the work site, vendor personnel will transport the explosives to an area designated by CB&I UXO personnel. The SUXOS and explosives driver will ensure that passengers are not carrying any smoking products or flame-producing devices. Smoking will be strictly forbidden among all personnel involved in the handling or transportation of explosives.

5.4.2 Vehicle Requirements

As required, CB&I UXO personnel will schedule a demolition operation and the required explosives will be delivered directly to the site by an authorized and licensed explosives vendor. Access through the FTSW gate will be coordinated through the FTSW DPW in advance. DPW will be provided with the following information prior to the delivery of explosives:

- Name of explosives vendor
- Complete list of explosives to be delivered and a statement that the delivery vehicle is in possession of the appropriate shipping documentation
- Make, model, and license plate number of the delivery vehicle
- Name and citizenship information of the driver
- Delivery time window

After issue at the site, CB&I will transport the explosives to the actual demolition site on foot. If transporting explosives by road, CB&I will comply with the following requirements:

- Vehicles transporting explosives will be placarded when carrying any Class 1 explosives.
- All vehicles transporting explosives will be equipped with reliable communications, a first-aid kit, and two 10-pound "BC"-type fire extinguishers. One extinguisher will be located in the driver's compartment and the other located in the cargo compartment.
- Vehicles transporting explosives will be inspected in accordance with DD Form 626, and the inspections will be documented on an explosives transportation vehicle safety checklist, which will be kept in the vehicle during transport.
- The vehicle used to transport the explosives will have a non-sparking bed liner, and all explosive loads will be covered prior to departure.
- The driver of any explosive-laden vehicle will ensure that the load is properly braced and that the initiators are carried separately from main charge explosives.
- There will be no smoking within 50 feet of explosives.
- Radios and mobile phones may be a hazard when carrying electric detonators; however, non-electric detonators are not affected by radio transmissions and will be used.

5.5 RECEIPT PROCEDURES

This section describes the procedures that CB&I will use to maintain records of explosives received.

5.5.1 Inventory Control and Records Management

An accurate running inventory of all explosives on site will be maintained. Copies of all paperwork pertaining to explosives delivery will be maintained by the SUXOS.

5.5.2 Authorized Individuals

The SUXOS will be responsible for the proper receipt and issue of explosives for detonation purposes. The SUXOS may authorize other specific individuals to perform the receipt and initial inventory of the explosives, but cannot delegate the responsibility for ensuring that the inventory, receipt, daily storage, and handling of the explosives is performed in accordance with the requirements of this plan. Any individual authorized to receive explosives will be at least a UXO Technician III.

5.5.3 End User Certification

The SUXOS or UXO Technician III, as the end user of explosives, will certify in writing that the explosives were used for their intended purpose. This information is tracked on the Explosive Usage Form (**Appendix D**).

5.5.4 Reconciling Discrepancies

In the event that there is a discrepancy with any aspect of the management of explosives, the SUXOS will be immediately notified. The SUXOS, together with the UXOSO and UXOQCS, will review documentation to determine whether the discrepancy is a paperwork error or whether explosives have been lost or stolen. If it is concluded that explosives have been lost or stolen, the USACE OE Safety Specialist will be notified.

5.6 INVENTORY

The SUXOS will inventory explosives upon delivery to the site and maintain records for all explosive materials received and expended. There are no storage facilities on site, so all explosives will be expended.

5.7 LOST, STOLEN, OR UNAUTHORIZED USE OF EXPLOSIVES

If explosives are discovered to be lost, stolen, or used without authorization, the incident will be immediately reported to the SUXOS, who in turn, will inform the FTSW Military Police, DPW, USACE, and the CB&I PM, as required.

As the federal licensee, CB&I is required by law (27 CFR 55.30) to report the theft or loss of explosives to the ATF within 24 hours. In the event of such an occurrence, the following procedures will be implemented:

- CB&I will make the appropriate notifications in accordance with 27 CFR 55.30. These will include calling the ATF (800-461-8841 or 888-283-2662) and the local law enforcement authorities.
- CB&I will be responsible for completing and forwarding ATF Form 5400.5. This form will be completed by the SUXOS, and a copy will be provided to USACE.

5.8 DISPOSAL/STORAGE OF EXPLOSIVES

All explosives delivered to the site for a day of detonations will be consumed on that day. There will be no storage of explosives.

6.0 EXPLOSIVES SITING PLAN

An ESP was developed in accordance with DID MR-005-04, Federal Acquisition Regulation 45.5, ATF P 5400.7 (ATF, 2000), DoD 6055.9-STD (DoD, 2009), and Army Regulation 190-11 (Army, 1998). The ESP is contained under separate cover.

7.0 ENVIRONMENTAL PROTECTION PLAN

7.1 INTRODUCTION

The purpose of this EPP is to describe the approach, methods, and procedures to be employed by CB&I to protect the natural, cultural, and archaeological environments during performance of tasks associated with the RFI. Specifically, this EPP describes the procedures and methods that will be implemented during site activities to minimize pollution, protect and conserve natural resources, restore damaged areas, and control noise and dust within reasonable limits.

7.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

CB&I will follow all applicable regulations concerning environmental protection, pollution control, and abatement necessary for the proposed field operations. Applicable statutes may include, but are not limited to, the following:

- Endangered Species Act (ESA), Title 16 United States Code (USC) §§1536(a) and (c); Title 16 USC §1538
- Migratory Bird Treaty Act, Title 16 USC §§ 703-712
- Archaeological and Historical Data Preservation Act, Title 16 USC §§ 469-489c2
- National Historic Preservation Act, Title 16 USC §§470-470b
- Solid Waste Disposal Act, Title 42 USC §7401 et seq.
- RCRA, Title 42 USC §6969 et seq.
- Clean Water Act, Title 33 USC §1344
- Clean Air Act Amendments, Title 42 USC §7401

7.3 IDENTIFICATION OF ENVIRONMENTAL RESOURCES

7.3.1 Endangered, Threatened, and Sensitive Species

"Endangered" or "threatened" species are designated in 50 CFR, §§ 17.7 or 17.12 List(s) of Endangered and Threatened Wildlife and Plants, under the ESA. Endangered species are those in imminent jeopardy of extinction, while threatened species are determined to be threatened with extinction. "Proposed" means the species has been proposed in the Federal Register for possible action to the above-referenced list. Candidate Species and Species of Concern are designations that do not afford the species protection under the ESA. There are seven threatened and endangered animal species at FTSW. These species and their status are listed in **Table 7-1**.

Table 7-1
Threatened and Endangered Species

Common Name	Scientific Name	Status
Wood Stork	*Mycteria Americana*	FE/SE
Shortnose Sturgeon	*Acipenser brevirostrum*	FE/SE
Gopher Tortoise	*Gopherus polyphemus*	FT
Red-Cockaded Woodpecker	*Picoides borealis*	FE/SE
Bald eagle	*Haliaeetus leucocephalus*	ST
Eastern Indigo Snake	*Drymarchon corais couperi*	FT/ST
Frosted Flatwoods Salamander	*Ambystoma cingulatum*	FT/ST
FE - Federal Endangered FT - Federal Threatened SE - State Endangered ST - State Threatened		

Source: http://www.stewart.army.mil/dpw/wildlife/the%20management.htm

The specific location for these sensitive species is not available based on a review of the Integrated Natural Resource Management Plan (INRMP). However, a basic description and type of habitat is described below for worker recognition should such habitats be encountered. Special caution should be exercised for the terrestrial species (gopher tortoise and eastern indigo snake) which might easily be encountered while performing transect investigations in wooded areas of the MRSs.

The gopher tortoise is a fairly large terrestrial turtle which possesses forefeet well adapted for burrowing, and elephantine hind feet. These features are common to most tortoises. The front legs have scales to protect the tortoise while burrowing. They are dark brown to gray-black in overall color, with a yellow plastron (bottom shell). Carapace length can range from 7.9 to 11.8 inches. Gopher tortoises spend most of their time in long burrows, up to 48 feet in length and 9.8 feet deep. Burrows are especially common in longleaf pine savannas. Females may lay clutches of 3–14 eggs in a sandy mound very close to the entrance of their burrow.

The eastern indigo snake is a large nonvenomous snake noted as being the longest native snake species in the U.S. The eastern indigo snake has even blue-black dorsal and lateral scales, with some specimens having a reddish-orange to tan color on the throat, cheeks, and chin. This snake received its common name from the glossy iridescent ventral scales which can be seen as blackish-purple in bright light. Eastern indigo snakes frequent flatwoods, hammocks, dry glades, stream bottoms, cane fields, riparian thickets, and high ground with well-drained, sandy soils. In Georgia, eastern indigo snakes prefer excessively drained, deep sandy soils along major streams. From December to April, eastern indigo snakes prefer sandhill habitats; from May to July, the snakes shift from winter dens to summer territories; and from August through November, they are located more frequently in shady creek bottoms than during other seasons.

The frosted flatwoods salamander has a small, indistinct head, short legs, and a long, rounded tail. Typical coloration consists of a background of brownish- to purplish-black overlaid with narrow gray or silvery-white reticulations (net-like markings), bands, or diffuse spotting. It inhabits seasonally wet pine flatwoods and pine savannas. Adult salamanders spend most of the year underground in burrows, especially those of crayfish, where they feed on a variety of small invertebrates. From September through December, adults migrate from surrounding upland habitats to their natal wetlands during rainfall events associated with passing cold fronts.

The wood stork is a large American wading bird which stands 33–45 inches tall. It appears all white on the ground, with blackish-gray legs and pink feet. In flight, the trailing edge of the wings is black. The head is dark brown with a bald, black face, and the thick downcurved bill is dusky yellow. It forages usually where lowering water levels concentrate fish in open wetlands.

The red-cockaded woodpecker is small to mid-sized species, measuring 7–9 inches in length. Its back is barred with black and white horizontal stripes. The red-cockaded woodpecker's most distinguishing feature is a black cap and nape that encircle large white cheek patches. The male has a small red streak on each side of its black cap called a cockade, hence its name. The red-cockaded woodpecker makes its home in mature pine forests. While other woodpeckers bore out cavities in dead trees where the wood is rotten and soft, the red-cockaded woodpecker is the only one which excavates cavities exclusively in living pine trees.

The bald eagle is found near large bodies of open water with an abundant food supply and old-growth trees for nesting. The bald eagle is an opportunistic feeder which subsists mainly on fish, which it swoops down and snatches from the water with its talons. The bald eagle is mainly brown with a white head and tail. The beak is large and hooked. The beak, feet, and irises are bright yellow. The bald eagle has a body length of 28–40 inches.

The shortnose sturgeon can be found in large river and estuary systems. No work will be done in such habitat.

7.3.2 Water Resources

FTSW is located within the Canoochee River watershed. In the northwestern, central, and southeastern portions of FTSW, the majority of surface water drains into the Canoochee River. Surface water also drains into the Ogeechee River and Altamaha River in the northeastern and southwestern portions of the Installation, respectively.

Four major lakes and ponds are located on FTSW: Pineview Lake, Glissons Pond, Holbrook Pond, and Cantonment Pond. These surface water features are not present within the MRSs covered in this work plan.

Approximately 82,148 acres of wetlands have been identified on FTSW, which represents approximately 30 percent of the total area (see **Figure 7-1**). Wetland types identified at FTSW include black water swamps, bay forests, stream head pocosins, wet pine flat woods, and cypress-gum swamps. The INRMP did not provide sufficient data to identify which wetland type is present in each MRS. However, the following total wetland acreages are present within each MRS based on the available GIS layer.

Site	Wetlands (acres)
Anti-Aircraft Range - 4B	239.3
Anti-Tank Range 90-MM-2	73.4
Grenade Launcher Range	6.6

Field crews will operate on foot in wetland areas to limit impacts to wetland vegetation or associated water resources. Excavations will be performed with hand shovels and only limited vegetation removal will occur. If excavations become excessive such that vegetation removal in contiguous areas larger than 3 feet occur, then FTSW will be consulted. Detonation of MEC, if necessary, may create small openings or depressions. If possible, detonations may be relocated outside of wetlands if coordinated with the OE Safety Specialist.

7.3.3 Trees, Shrubs, and Plant Communities

Within FTSW, four types of ecosystems are present: sand hills, pine flatwoods, upland forests, and wetlands. The INRMP did not provide sufficient data to identify which ecosystem is present in each MRS. Mixed coniferous and deciduous trees can be found in the sand hills and the upland forests. Pine species can be found in the flat woods.

Major tree species located within FTSW include longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), loblolly pine (*Pinus taeda*), tupelo (*Nyssa sylvatica*), other gums (*Nyssa spp*.), water oak (*Quercus nigra*), and bald cypress (*Taxodium distichum*) (Arcadis/Malcolm Pirnie, 2011).

Although minor removal of underbrush may be performed, RI activities are not expected to alter vegetation in a permanent way. No trees greater than 4 inches in diameter will be cut unless specifically approved by FTSW.

7.3.4 Cultural and Archeological Resources

If RFI field activities identify potential cultural or archeological sites, CB&I will work closely with FTSW DPW-ENRD to either avoid intrusive excavations in such sites (if possible while still collecting sufficient site characterization data) or to provide the appropriate level of archaeological oversight and documentation. Should any historical, archaeological items, cultural or biological resources or skeletal remains be discovered, all work will cease immediately and the Contracting Officer will be notified as well as the FTSW DPW point of contact.

7.3.5 Existing Waste Disposal Sites

There are several former landfill and dump areas on the facility. However, no landfills or dump areas are present within the MRSs presented in this work plan. If waste disposal sites are encountered, the location and nature of the site will be noted and reported to USACE and FTSW.

7.4 PROPOSED MITIGATION MEASURES

7.4.1 Manifesting, Transportation, and Waste Disposal

Production of hazardous wastes is not anticipated. MEC/MPPEH items that require destruction or venting will be destroyed in demolition operations, followed by recovery and disposal of the nonhazardous fragments off site from FTSW. When explosive disposal of MEC/MPPEH is determined appropriate, explosives will be brought to the location and detonated.

Appropriate on-site housekeeping practices will be maintained during the course of the project, to include maintaining a clean work space and disposing of trash properly. All project wastes will be collected and disposed of in accordance with Section 3.6.

7.4.2 Burning Activities

No burning will take place on FTSW as part of the RFI activities. Any activities that could potentially cause a spark (such as during demolition operations) will be carefully monitored. Fire extinguishers will be present during demolition operations, and an assessment of vegetation conditions will be made prior to each detonation. If the vegetation is dry and may pose a wildfire hazard, precautionary measures will be taken. This may include spraying water on the dry vegetation. Motor vehicles are not anticipated to be operated or parked on vegetated areas. Fire prevention measures and emergency response plans for fire control are discussed in the APP, which is included as a separate document.

7.4.3 Dust and Emission Control

Based on the limited disturbance of soil planned and the vegetated conditions in the sandy soil, field operations are not anticipated to generate an amount of dust that would require dust control measures.

7.4.4 Spill Control and Prevention

Use of equipment on site will be limited. Refueling of vehicles will be conducted off of FTSW. Refueling of other equipment, such as generators or similar equipment, will be conducted in a safe manner. To control possible spills of potentially hazardous liquids, such as gasoline, all liquids will be stored in approved containers. When dispensing these fluids, personnel will do so on a leak-proof surface, such as a plastic or metal-lined tray, whenever possible. If a spill does occur when refueling equipment, it will be immediately cleaned up using procedures discussed in the APP and the materials contained while awaiting disposal. Emergency response plans for spills and leaks are discussed in the APP, which is included as a separate document.

7.4.5 Storage Areas and Temporary Facilities

Temporary facilities, such as personnel trailers and temporary waste staging areas, if required, will be staged so as to minimize disturbance of native vegetation or interference with investigation areas. CB&I will coordinate the locations of these temporary facilities with the FTSW environmental office prior to mobilizing them to the field. All temporary storage and facilities will be removed upon completion of the RFI activities.

7.4.6 Access Routes

Field operations will not require construction of new access roads. CB&I will coordinate with FTSW regarding the use and restriction of roads, including use of access roads.

7.4.7 Protection and Restoration of Trees and Shrubs

Only areas with transects/grids, or other areas necessary for access, will be disturbed. No trees, shrubs, or other vegetation greater than 4 inches in diameter will be cut, cleared, or otherwise disturbed unless specifically necessary. Such cases will be coordinated with FTSW environmental office. No replacement of trees or shrubs will be performed for site restoration.

7.4.8 Control of Water Run-On and Runoff

As RFI field activities will be limited to subsurface intrusive investigation of anomalies, and no significant excavation that cannot be completed in 1 day is anticipated, no efforts are planned to control or divert run-on or runoff. No excavations will be left open overnight.

7.4.9 Decontamination and Disposal of Equipment

No liquid waste is anticipated, as all sampling equipment will be dedicated and not require liquid decontamination. Extra soil will be returned to soil borings. Solid waste may be generated as a result of disposal of dedicated equipment and other non-contaminated trash. Non-contaminated trash will be disposed of as municipal waste. Hazardous waste is not anticipated based on planned project activities (i.e., minor digging with all soil returned to the excavation and no liquid waste streams) and the current understanding of the site (i.e., no known sources of hazardous media). Dedicated sampling equipment, batteries (9-volt for Schonstedt instruments), and disposable personal protective equipment can be disposed of with municipal waste.

7.4.10 Minimization of Disturbed Area

To minimize the impacts of vehicles and other equipment within the FTSW, vehicles will remain on existing roads.

7.5 POST-ACTIVITY CLEANUP

Following completion of fieldwork activities, all debris created during the project will be removed and disposed of in accordance with any FTSW regulations. MDAS and other investigative-derived waste will be disposed or recycled in accordance with Section 3.6.

7.6 AIR MONITORING PLAN

No contact or potential contact with hazardous materials is expected within the investigation areas; therefore, no routine air monitoring will be undertaken. Should potential chemical hazards be discovered, an appropriate monitoring plan shall be developed and implemented prior to continuation of the investigation to verify compliance with applicable laws and regulations.

8.0 PROPERTY MANAGEMENT PLAN

This Property Management Plan describes how government property will be managed for this project.

8.1 GOVERNMENT PROPERTY

Property used on the FTSW RFI project can include both government property and CB&I property. Government property can include:

- Government Furnished Property—Property directly acquired and furnished to the project by the Government.
- Contractor-Acquired Property—Property directly purchased by the contractor for the project using Government funds.

There are no plans to obtain government property for this project. If government property is received or purchased by CB&I, it will be managed according to the following guidelines.

8.2 PURCHASE REQUISITION PROCEDURES

Acquisitions will be carefully managed in accordance with Federal Acquisition Regulations.

8.3 STORAGE

Government property will be stored in an organized manner so that inventory of the material can easily be performed on a regular basis.

8.4 PROPERTY TRACKING

All Government property will be tracked to ensure all items are maintained in accordance with the procedures outlined in this Property Management Plan. All property will be classified into two main categories:

- Expendable Property—Supplies and materials that are consumed or expended routinely and lose their identity under contract performance. Expendable property includes small tools with a unit value of not more than $250.
- Non-Expendable Property—Property which is durable with an expected useful life of one or more years, is complete in itself, and does not lose its identity or become a component part of another item.

A unique tracking number will be assigned and affixed to all non-expendable property to facilitate future identification of the item. Property inventories will be updated on a monthly basis for the duration of the project. A tracking report will be will be submitted to USACE as part of the monthly report. This report will detail the following:

- Description
- Tracking number
- Unit price
- Quantity purchased
- Date purchased
- Quantity on hand
- Location of property
- Category (expendable or non-expendable)
- Status (note if property is active, lost, damaged, or destroyed)

All property to be used as part of the project will be inventoried on a monthly basis. A visual identification and physical inspection will be performed, and the property inventory will be updated noting changes in quantity, location, and/or property status. All damaged or missing items will be noted in the property inventory and the need for replacement will be evaluated.

8.5 ULTIMATE DISPOSITION

At the completion of the project, non-expendable Government Property will be made available to USACE according to direction from the Contracting Officer.

9.0 INTERIM HOLDING FACILITY SITING PLAN FOR RECOVERED CHEMICAL WARFARE MATERIEL PROJECTS

An Interim Holding Facility Siting Plan for recovered CWM is not applicable to the FTSW Project.

10.0 PHYSICAL SECURITY PLAN FOR RECOVERED CHEMICAL WARFARE MATERIEL PROJECT SITES

A Physical Security Plan for recovered CWM is not applicable to the FTSW Project.

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Appendix A
Task Order Statement of Work

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

SUMMARY OF CHANGES

SECTION C - DESCRIPTIONS AND SPECIFICATIONS

The following have been modified:
PERFORMANCE WORK STATEMENT

Fort Stewart PBA13
Fort Stewart, Georgia
PERFORMANCE WORK STATEMENT

Date: 01 February 2013
REV: 0

1.0 Introduction and Background

This requirement is for environmental remediation services for four (4) Military Munitions Response Program (MMRP) sites at Fort Stewart, located in Hinesville, GA. The Department of Defense (DoD) established the MMRP under the Defense Environmental Restoration Program (DERP) to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations. Environmental services in this Performance Work Statement (PWS) include: Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFI). This is a performance-based, firm fixed price task order.

Fort Stewart (FTSW) consists of 279,081 acres and is located north of Hinesville, GA, approximately 40 miles southwest of Savannah, GA. FTSW is the largest Army installation east of the Mississippi River, spanning portions of Bryan, Evans, Liberty, Long, and Tattnall counties. Georgia Highway 119, which runs north to south from Pembroke to Hinesville, and Georgia Highway144, which runs east to west from Richmond Hill to Glennville, bisect FTSW. 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.

Construction of the reservation that was to become FTSW began on September 10, 1940, on what was formerly the Camp Savannah Anti-Aircraft Firing Center. On November 18, 1940, the reservation’s name was changed from Camp Savannah to Camp Stewart in honor of the Revolutionary War Brigadier General Daniel Stewart. The reservation was established as an antiaircraft center with facilities to prepare artillery troops for overseas deployment. The reservation’s mission of training anti-aircraft units ended on November 20, 1944, and all training terminated in December 1944. Army ground forces units were to have departed by April 30, 1945. A prisoner-of-war camp that was operated at the reservation was also closed. The reservation’s mission was reestablished as a separation center for redeployed troops from August 6, 1945, until September 2, 1945. On September 30, 1945, Camp Stewart was inactivated, and the reservation became a location for training the Georgia National Guard. From a peak strength of 55,000 soldiers during the spring of 1944, only two officers, 10 enlisted men, and 50 civilian employees remained by the fall of 1945 to maintain the facilities.

With the outbreak of hostilities in Korea in June 1950, Camp Stewart was reactivated on August 9, 1950, and was designated the 3rd Army Anti-Aircraft Artillery Training Center. In 1953, armor and tank training was added to the mission of the reservation. On March 21, 1956, Camp Stewart was redesignated as Fort Stewart and was designated a permanent Army installation. In 1959, FTSW became an armor and artillery firing center. Troop training at FTSW peaked in 1961 and 1962 in response to the Berlin and Cuban crises, respectively. The 1st Armored Division was relocated to the reservation during the Cuban crisis.

In response to a need for more helicopter and light fixed wing aircraft in support of the Vietnam conflict, an element of the U.S. Army Aviation School at Fort Rucker, Alabama, was transferred to FTSW in 1966. Helicopter pilot training and helicopter gunnery courses became the new mission for FTSW.

In 1967, the main mission for FTSW was to train Army aviators. The reservation was also used to maintain readiness for other active duty, Reserve, and National Guard personnel. In 1970, Vietnamese helicopter pilots began training at FTSW. Aviation training at FTSW was phased out in 1973, when all aviation training was consolidated at Fort Rucker. By 1974, FTSW had become a training and maneuver area, providing tank, field artillery, helicopter gunnery, and small arms training for Regular Army and National Guard units. FTSW supported training by providing facilities, conducting training opportunities, and assisting in the mobilization and deployment of troops.

In 1974, the 1st Battalion (Ranger), 75th Infantry was activated at FTSW. Later that year, the 24th Infantry Division was activated on the reservation. Currently, the 3rd Infantry Division (Mechanized) is the major unit located at FTSW.

FTSW is the home of the third infantry division (mechanized) (3ID[M]), with the following major units: 1st Brigade, 3ID(M); 2nd Brigade, 3ID(M); 3ID Artillery; 3ID Support Command; 3ID Engineer Brigade; 3/7 Cavalry; 1/3 Air Defense Artillery; 103d Military Intelligence Battalion; 123d Signal Battalion; 3d Military Police Battalion (Provisional); and 24th Corps Support Groups. The 3d Brigade, 3ID(M) operates out of Fort Benning, GA, but often trains at FTSW. Currently, the mission of FTSW is to sustain a quality of life and reservation support at the level necessary for divisions and non-divisional, tenant, and Reserve Component units to accomplish their training missions.

1.1 Previous Studies and Events

Construction of 4th Infantry Brigade Combat Team (IBCT) Complex - In June of 2009, the United States army Corps of Engineers (USACE) Savannah District began military construction on the 4th Infantry Brigade Combat Team (IBCT) Complex. The IBCT occupied approximately 457 acres at the Anti-Aircraft Range – 4 MRS (FTSW-009-R-01). Numerous EOD responses were reported during construction of the facility. In December 2011, the Resident Engineer suspended earthmoving due to a MEC find during backfilling operations in the IBCT.

Time Critical Removal Action (TCRA) - In January 2011, USACE conducted a TCRA to: 1) remove potential MEC from approximately 50,000 CYs of staged soil at the FTSW-009-R-01 MRS; 2) complete a MEC clearance to depth of detection at the Anti-Aircraft Range – 4 MRS (FTSW-009-R-01), 10th Eng. Battalion Construction Site (70 acre site); 3) complete a MEC clearance to depth of detection at the Anti-Aircraft Range-4 MRS (FTSW-009-R-01), Dog Kennel Site (10 Acres).

MEC Quality Assurance (QA) Investigation to Depth of Detection: During the period of 14-26 February 2011, USACE conducted a MEC Quality Assurance Investigation to Depth of Detection on areas of interest within the 5th IBCT construction site within the Anti-Aircraft Range – 4 MRS (FTSW-009-R-01) at Fort Stewart (**note name change from 4th to 5th IBCT during this time period**). The investigation consisted of conducting subsurface magnetometer investigations on pre-staged suspect soil piles and in areas where suspect soil had been spread. The purpose of this investigation was to determine if MEC hazards existed and if so to locate and remove all MEC hazards in order to allow safe construction activities to continue. The results of this investigation indicated that construction efforts on the site were safe to continue following "low probability" for encountering MEC protocols.

MEC Quality Assurance (QA) Follow-on Investigation to Depth of Detection: During the period of 11-29 April 2011, USACE conducted a MEC Quality Assurance Investigation to Depth of Detection on areas of interest not previously investigated, within the 5th IBCT construction site within the Anti-Aircraft Range – 4 MRS (FTSW-009-R-01) at Fort Stewart GA. The investigation consisted of conducting subsurface magnetometer investigations on areas not under soil piles/buildings/pavement and that had not been investigated previously. The purpose of this investigation was to verify that these remaining areas could be classified as "low probability" for encountering MEC per the guidance established in the Department of Defense Explosive Safety Manual (DoDM 6055.09-M-V7). The results of this investigation indicated that construction efforts on the site were safe to continue following "low probability" for encountering MEC protocols

Army and Airforce Exchange Service (AFFES) Shoppette Highway 144 Construction Site - In February of 2011, the USACE conducted a MEC Investigation to Depth of Detection on a five acre site identified as the AFFES Mini Mart Future Construction Site located in close proximity to the 5th IBTC, and within the Anti-Aircraft Range – 4 MRS (FTSW-009-R-01). The purpose of this action was to verify that the site was safe for future construction activities. During the period of 13 – 21 April 2011 the team completed investigative activities under "low probability" protocols. The results of this investigation indicate that construction efforts on the site are safe to continue following "low probability" for encountering MEC protocols.

Final Preliminary Investigation/TCRA for the Small Arms Range Berm Area of MMRP Site FTSW-006-R-01, March 2012 - Between October 2009 and September 2010, soil borings, temporary and permanent monitoring wells, groundwater, surface water, and sediment samples were collected from FTSW-006-R-01. Samples were analyzed for antimony, copper, and lead. The objective of the investigation was to provide confirmation sampling results for the 2008 soil removal conducted at the former berm area and to provide further information regarding potential contaminants of concern that could impact land use change and MILCON in the area. All soil and sediment sample results were below the EPA RSL of 400 mg/kg for lead. Lead was above the screening value in several surface water samples. No contaminants of concern were above screening values in groundwater.

Phase 2 CS Report - In June 2012, a Phase 2 CS Report was completed on a 1,072 acre parcel or land that had been made other-than-operational to expand the cantonment area at Fort Stewart. The Phase 2 SI Report identified five sites: the Anti-Aircraft Range – 4A MRS (FTSW-009-R-01), Anti-Aircraft Range – 4B MRS (FTSW-009-R-02), Anti-Tank Range 90-MM – 2 MRS (FTSW-010-R-01), Grenade Launcher Range MRS (FTSW-011-R-01), and Small Arms Range - 2 MRS (FTSW-006-R-01). This is currently under contract for RFI and excluded from this PWS. These sites were recommended for RFI for MEC and/or MC in the final Phase 2 CS Report.

2.0 Requirements

The Department of Defense (DoD) established the MMRP under the Defense Environmental Restoration Program (DERP) to address unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC) located on current and former military installations. Work required under this PWS falls under the Military Munitions Response Program (MMRP). All activities involving work in areas potentially containing MEC hazards will be conducted in full compliance with DoD, Department of the Army and United States Army Corps of Engineers (USACE) safety regulations.

The Contractor shall be responsible for fully executing the Firm Fixed Price Remediation (FFPR) approach under a Performance-Based Acquisition (PBA) by: conducting required environmental investigative and restoration services for which the United States Department of the Army (the "Army") is statutorily responsible; addressing any and all environmental, explosive safety, scheduling, and regulatory issues; and, assuming contractual liability and responsibility for the achievement of the performance objectives for the MMRP sites at Fort Stewart (the "Installation") identified in this Performance Work Statement (PWS), including any sites with off-installation contamination for which the Army is responsible.

The contractor must possess all the required expertise, knowledge, equipment and tools required to meet or exceed the government's objectives identified in this PWS in accordance with established industry standards. The Contractor must have the capability and experience to perform, or provide investigative and restoration services required for hazardous substance and waste sites and munitions and explosives of concern (MEC). Work will include one or more of the following: Studies and Reports, and the Remedial Investigation of MEC and Munitions Constituents (MC).

Under this task order, the contractor will perform munitions response actions for military munitions (MM) and munitions debris (MD). Activities may involve munitions and explosives of concern (MEC), which includes UXO, DMM, and MC if found in high enough concentrations to cause an explosive threat, non-explosive concentrations of MC and incidental contaminants related to MM.

It is the Contractor's responsibility to comply with all applicable federal, state and local laws and regulations and to fulfill the performance objectives of this PWS in a manner that is consistent with any applicable orders or permits, all existing cleanup agreements or guidance for the Installation, and relevant DoD and Army policy, for the duration of the contract.

The Contractor must perform all the necessary environmental remediation work as required to meet the performance objectives of this PWS. Remediation of Fort Stewart MMRP sites is being conducted pursuant to the Georgia Environmental Protection Division (GAEPD) issued RCRA Part B Permit, Section III, Corrective Action, with regulatory coordination, as appropriate, with the GAEPD and the United States Environmental Protection Agency (USEPA) Region IV. The DoD Ammunition and Explosives Safety Standards (DoDM 6055.09-M, DoD Ammunition and Explosives Safety Standards, 29 February 2008, Administratively Reissued 4 August 2010) must be adhered to in the investigation and remediation of sites with MEC. Specific requirements concerning explosives safety under the Active MMRP are further clarified in ER 385-1-95, EM 385-1-97, and EP 385-1-95a.

Certain pollutants or contaminants (P/C) may be an issue at sites covered by this task order. Cleanup of P/C may be warranted if the P/C presents an imminent and substantial endangerment to the public health or welfare that result in an unacceptable risk. P/C typically do not have a federally promulgated maximum contaminant limit (MCL). For any such P/C, or any other chemical, that does not have a federally promulgated MCL, but does have a finalized reference dose (RfD) or slope factor listed in USEPA's Integrated Risk Information System (IRIS) database, that RfD or slope factor should be incorporated in the risk assessment process. However, funding will not be provided for responses that are not in full compliance with RCRA, the Defense Environmental Restoration Program (DERP), and DoD and Army policy.

3.0 Types of Services Required

This PWS includes the following types of services as authorized in Section C.1.2.1 and C.1.2.2 of the basic contract:

- Studies and Reports
- Remedial Investigation for MEC/MC
- MEC hazard assessments and human health risk assessments for MC
- Characterization
- Excavation of test pits/trenches
- Digital geophysical mapping
- Inspection of MPPEH and disposal of munitions debris
- On-site MEC destruction efforts
- Borings and groundwater monitoring wells
- Sampling and analysis of soil, sediment, groundwater, surface water,

- Management of investigative derived waste (IDW) to include disposal of IDW

4.0 Task Order Type

This is a firm fixed-price task order without environmental insurance. The period of performance on this Task Order is not to exceed 36 month from the date of the award.

5.0 Performance Objectives and Standards

The Contractor shall be required to furnish all plant, labor, materials and equipment necessary to meet the performance objectives and standards identified in **Table 1** below. The current status of the remediation efforts for each site can be found in the documents provided in **Table 2** of this Task Order.

Table 1: Performance Requirements Summary.

Performance Objective	*Performance Measure*
Approved Project Management Plan (PMP) and Quality Assurance Surveillance Plan (QASP): • Draft PMP and draft QASP within 30 calendar days of Task Order award, • Final PMP within 15 days calendar of receipt of COR comments on the drafts.	Army approval through the Contracting Officer's Representative (COR).
Achieve RCRA Facility Investigation (RFI) at the following sites within 36 months of NTP: • Anti-Aircraft Range 4A – (FTSW-009-R-01) • Anti-Aircraft Range 4B – (FTSW-009-R-02) • Anti-Tank Range 90-MM – 2 (FTSW-010-R-01) • Grenade Launcher Range (FTSW-011-R-01)	Compliance with the Government provided, DDESB approved Explosives Siting Plan (ESP). Army approval through the COR and Regulator concurrence (e.g., receipt of documentation confirming approval of RFI Report).

There may be multiple milestones and/or deliverables for each performance objective (see Section 6.2 of this PWS). Payments will be based on successful completion of the milestones. Final decisions regarding the adequacy of milestone and deliverable completion resides with the COR (see Section 8.3 of this PWS), with appropriate acceptance and approval of necessary site remediation documentation by regulators, consistent with applicable regulatory drivers listed in Section 2.0 of this PWS.

6.0 Project Management

The PBA approach requires careful coordination of project activities to ensure that all stakeholders are kept informed of the project status, existing or potential problems, and any changes required to prudently manage the project and meet the needs of the Installation's project stakeholders and decision-makers. The Contractor shall be responsible for the following project management activities:

6.1 Project Management Plan and Schedule

The Contractor will develop and maintain a detailed Project Management Plan (PMP). The PMP, based on the schedule prepared as part of the Contractor proposal, will specify the schedule, technical approach, and resources required for the planning, execution, and completion of the performance objectives. The first draft of the PMP will be due within thirty (30) calendar days of contract award. The draft PMP and subsequent revisions will be subject to Army review and approval through the Contracting Officer's Representative (COR). The final PMP will be due within fifteen (15) calendar days of comments received from the COR. A payment milestone will be established for Army approval of the final PMP through the COR.
As part of the PMP, the Contractor will develop and maintain an activity-based schedule that fully supports the technical approach and outlines the due dates for all milestones and payable deliverables. A payment plan will be included with the schedule that allows for payments to the Contractor based on successful completion of interim milestones proposed by the Contractor. It is the Army's intent to make all payments after verification of progress in accordance with this schedule. The Contractor will coordinate activities with the COR to ensure that the proposed project schedule does not conflict with other contractor activities on site, or interrupt Installation mission activities.

As part of the PMP, the Contractor will identify and implement a means for providing project status reports to the COR. The PMP will address the frequency and content of status reports.

6.2 Milestone Presentations

Milestone presentations shall be made to the COR at the completion of each milestone below to provide analysis and lessons learned, and to present approaches for completion of future milestones. At the COR's request, the Contractor may also make milestone presentations to the other project stakeholders, consistent with the applicable regulatory drivers listed in **Section 2.0** of this PWS, to show achievement of the performance objectives. This includes participation in annual Installation Action Plan (IAP) meetings, if requested by the COR.

The Contractor may propose a revision of the milestones below to reflect their PMP and provide for interim milestones. Interim milestones will only be accepted if they represent significant progress toward milestone completion, and completion of these interim steps can be measured and demonstrated. Payments will be tied to the successful completion major milestones listed below or an interim milestone plan approved by the Army, through the COR. To that end, all proposed interim milestones should be associated with easily demonstrated metrics tied to performance measurements (e.g., resolution of comments on a draft, acceptance of a final report, or acceptance of a data submittal or meeting minutes). All milestones must have a defined means for demonstrating completion in order to facilitate certification and approval (see **Section 8.3**, *Certification and Approval of Project Milestones and Deliverables*).

Major Milestones
· Approval of the Project Management Plan.
· Achievement of (acceptance/approval of) RFI at Anti-Aircraft Range 4A – (FTSW-009-R-01) within 36 months of NTP.
· Achievement of (acceptance/approval of) RFI at Anti-Aircraft Range 4B – (FTSW-009-R-02) within 36 months of NTP.
· Achievement of (acceptance/approval of) RFI at Anti-Tank Range 90-MM – 2 (FTSW-010-R-01) within 36 months of NTP.
· Achievement of (acceptance/approval of) RFI at Grenade Launcher Range (FTSW-011-R-01) within 36 months of NTP.

6.3 Environmental Requirements

The Contractor will identify: applicable Federal, State and local rules, laws, and regulations; applicable Installation-specific orders, agreements, or rules; as well as Army and DOD requirements, such as those established by the DoD Explosive Safety Board; and perform its work in accordance with said authorities. The Contractor will ensure that all activities performed by its personnel, subcontractors and suppliers are executed in accordance with said authorities. Any incident of noncompliance noted by the Contractor will immediately be brought to the attention of the COR and Installation telephonically and then by written notice. Nothing in this contract will relieve the Contractor of its responsibility to comply with applicable laws and regulations. The Contractor will obtain all approvals and permits (e.g., excavation, wetlands, NPDES, etc.), necessary to accomplish the work. When the work to be performed requires facility clearances, the Contractor will obtain them with the assistance of the Installation point of contact (POC) prior to any work and coordinate all work with that POC prior to initiation. Contractors are required to perform their own utility checks. The Contractor will comply with all Installation or site-specific time and procedural requirements (federal, state, and local) described in the approvals obtained. The Army technical experts will also independently review Contractor work to ensure compliance with all applicable requirements. POCs for questions on this PWS are listed in **Attachment D**.

The Army is in the process of establishing a Geographic Information System (GIS)-based tracking system to ensure that Land Use Controls (LUCs) are enforced. The LUCs have been incorporated into the post-wide Master Plan and are applicable to all units and activities, Military and Civilian Support Activities, tenant organizations and agencies and Government and Civilian Contractors.

The Contractor shall review and fully understand "Executive Order 13423 -- Strengthening Federal Environmental, Energy, and Transportation Management," in particular those requirements pertaining to environmental management system (EMS). The Contractor shall also be required to review and adhere to the installation's environmental management system, including the environmental policy and significant aspects / impacts.

The Contractor shall consider and implement green response/remediation strategies and applications to maximize sustainability, reduce energy and water usage, promote carbon neutrality, promote industrial materials reuse and recycling, and protect and preserve land resources, consistent with DOD’s Policy on Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program. The contractor shall present green remediation options and approaches in its work plans, maintain records of “greenrelated” activities, and report this information to the COR in its project status reports.

6.4 MEC Related Guidance

MEC includes, but may not be limited to: UXO, as defined in 10 U.S.C. 101(e)(5); DMM, as defined in 10 U.S.C. 2710(e)(2); or Munitions Constituents (MC), as defined in 10 U.S.C. 2710(e)(3), present in high enough concentrations to pose an explosive hazard.

MEC distinguishes specific categories of military munitions that may pose unique explosives safety risks. Because MEC that is being actively managed may be determined to be hazardous wastes, 29 Code of Federal Regulations (CFR), Hazardous Waste Operations and Emergency Response, Section 1910.120 may apply.

The Contractor will comply with all Installation or site-specific time and procedural requirements (federal, state, and local) described in the approvals obtained.
UXO qualified personnel IAW DDESB TP 18 Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel, 20 December 2004 will be responsible for determining the explosive safety status of any material recovered that may pose an explosive hazard (i.e., material potentially presenting an explosive hazard (MPPEH)).

Should MEC be encountered during this response, UXO-qualified personnel will evaluate the explosive hazard and remove it, including by open detonation in place. This response will be conducted per the CERCLA and the NCP, applicable state and federal regulations, and applicable DOD and U.S. Army policies and procedures, and U.S. Army Corps of Engineers (USACE) standards.

6.5 Health and Safety Requirements

Prior to beginning any field work, the Contractor shall produce a written Safety and Health Program (Accident Prevention Plan/Site Safety and Health Plan) in accordance with the provisions outlined in EM 385-1-1. Contractor shall pay particular attention to paragraph 01.A.11 in that “The contractor shall address each of the elements/sub-elements in the outline contained in Appendix A in the order they are provided in the manual. If an item is not applicable because of the nature of the work being performed then the contractor shall state this exception and provide justification.” Non-applicable plans shall not be included in the final Accident Prevention Plan. An Accident Prevention Plan (APP) checklist is provided as a guide for use in conjunction with the guidance outlined in Appendix A of USACE EM 385-1-1. The Contractor shall ensure that its employees, subcontractors, suppliers and support personnel follow all safety and health provisions established in the approved APP/Site Safety and Health Plan (SSHP). The APP and SSHP must be submitted to USACE at least 30 days prior to beginning work. USACE reserves the right to stop work under this contract for any violations at no additional cost to the Army. Once USACE verifies that corrective action has been implemented, the Contractor will be able to continue contract work. As a minimum, the SSHP shall contain the following elements: site description and contaminant characterization, Activity Hazard Analysis and Risk Assessment, safety and health staff organization and responsibilities, site specific training and medical surveillance parameters, personal protective equipment (PPE) and decontamination facilities and procedures to be used, monitoring and sampling required, safety and health work precautions and procedures, site control measures, on-site first aid and emergency equipment, emergency response plans and contingency procedures (on-site and offsite), logs, reports, and record keeping. Training and medical screening per 29 CFR 1910.120(e) is required for the contract.

Prior to beginning any field work, the Contractor shall implement a written Accident Prevent Plan in accordance with *Safety and Health Requirements Manual* EM 385-1-1. Additionally, the Contractor must adhere to all Department of Defense (DoD) policies, procedures and regulations for munitions response. Additionally, the Contractor must adhere to all DoD policies, procedures and regulations for munitions response. This could include, but is not limited to, DoDM 6055.09-M, DoD Ammunition and Explosives Safety Standards, 29 February 2008, Administratively Reissued 4 August 2010; Army Regulation 385-10, the Army Safety Program; Department of Army Safety Pamphlet 385-63, Range Safety; Department of Army Pamphlet 385-64, Ammunition and Explosives Safety Standards; and training and medical screening per 29 CFR 1910.120(e) and EM 385-1-97 USACE Explosive Safety and Health Requirements Manual.

The Government will provide an approved Conventional Explosives Siting Plan (ESP) that will be prepared IAW EP 385-1-97 Errata 3 and DoD Manual 6055.09-M, for this project. The ESP will describe, in detail, the appropriate safety criteria involved for the work included in this PWS. The contractor will be responsible for conducting all work in accordance with the approved ESP. Additionally; the Contractor must adhere to all DoD and DA policies, procedures and regulations for munitions response. This includes but is not limited to DoDM 6055.09-M, DoD Ammunition and Explosives Safety Standards, 29 February 2008, Administratively Reissued 4 August 2010; Army Regulation 385-10, the Army Safety Program; Department of the Army Pamphlet 385-63, Range Safety; Department of the Army Pamphlet 385-64, Ammunition and Explosives Safety Standards; and EM 385-1-1, US Army Corps of Engineers Safety and Health Requirements Manual, 15 September 2008.

Personnel involved in certain munitions response activities will, as required, meet the qualifications of Department of Defense Explosives Safety Board (DDESB), Technical Paper (TP) 18 - Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and UXOQualified Personnel. Per EP 1110-1-18, the contractor will propose a workweek schedule for each project. The proposed schedule will be submitted to the Contracting Officer (KO) for approval. The KO will seek the concurrence of the PDT and resolve any other comments before making the decision to accept or reject the schedule. If the schedule is rejected, the contractor will propose a new schedule and the same process will be repeated until an acceptable schedule is approved.

The sites are not suspected to contain CWM. If suspect CWM is encountered during any phase of site activities, the Contractor shall immediately halt operations and contact the COR for assistance and guidance.

All activities involving work in areas potentially containing MEC hazards shall be conducted in full compliance with Department of Army, state, and local requirements regarding personnel, equipment and procedures, and DoD Standard Operating Procedures and safety regulations.

6.6 Quality Management

The Contractor must ensure that the quality of all work performed or produced under this contract meets Army approval. Quality control/assurance plans must be prepared and approved by the COR prior to performance of physical work.

Since the technical approach for this PBA shall be developed by the Contractor, the Contractor shall also develop a proposed Quality Assurance Surveillance Plan (QASP) for use by the Army. A Draft QASP using the template provided on the CD shall be submitted with the PMP deliverables within thirty (30) calendar days of award. The Final QASP will be prepared by the Army.

The QASP will highlight key quality control activities or events that the COR will use to determine when Army (COR) inspections can be conducted to assess progress toward and/or completion of milestones. Activities identified in the QASP should be appropriately coded in the project schedule to allow for planning of QA inspections.

6.7 Quality Control

Quality Control shall be provided whenever sampling or analysis for chemical constituents or geophysics is required in order to achieve milestones. Quality control for traditional soils or geotechnical testing shall also be included. All sampling and analysis shall comply with the requirements of the most recently approved DoD Quality Systems Manual (QSM). The laboratory (ies) to be used by the Contractor shall be DoD Environmental Laboratory Accreditation Program (DoD ELAP) certified or equivalent. The Contractor may establish an on-site testing laboratory at the project site if determined necessary by the Contractor. However, on-site testing laboratory (ies) shall be DoD ELAP certified or equivalent and meet the requirements of USEPA, specific state regulator requirements, and all requirements of the most recently approved DoD Quality Systems Manual (QSM).

Following task order award and during project implementation, the Contractor shall develop and submit documentation of project-specific quality assurance (QA) and QC activities prepared in accordance with the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP). The Government will review and return the quality systems documentation, with comments, indicating acceptance or rejection. If necessary, the Contractor shall revise the documentation to address all comments and shall submit the revised documentation to the Government for acceptance. In addition, the Contractor shall develop and submit Quality Control Summary Reports to summarize the quality control details of the task order project. The problems and successes of the work done to control the quality of the chemical measuring activities and other chemically related cleanup activities shall be included in the summary reports.

6.8 Project Repository and Administrative Record

The Contractor shall update at least monthly a multimedia (i.e., both paper and electronic format) project repository of all project-related information to ensure that pertinent documentation and data are available for project reviews, and to provide a clear record of the PBA approach to support final decisions and remediation completion. This repository is the property of the Army and available to the Army upon request by the COR or KO. A project repository is currently maintained at: Directorate of Public Works, 1550 Frank Cochran Drive, Bldg 1137, Fort Stewart, GA 31314-4927. "Project-related information" includes all previous environmental restoration documentation of a technical nature developed by the Army and previous Army contractors for the sites specified in this PWS, and all the documentation developed by the Contractor in order to achieve the performance objectives specified in this PWS. Documents generated prior to the PBA are not expected to be stored in electronic format; however, all documents generated by the Contractor shall be maintained in multi-media form.

The Contractor shall also update the repositories for the Administrative Record for CERCLA/ RCRA activities established at: Directorate of Public Works, 1550 Frank Cochran Drive, Bldg 1137, Fort Stewart, GA 31314-4927, as needed. The project repository and Administrative Record shall be updated by the Contractor, and made available to the public, for the duration of the contract. Final electronic document files must be in text-searchable PDF format and be accompanied by defined metadata for upload into the Army Repository of Environmental Documents (READ). The Army, through the COR, will provide the metadata field requirements for READ to the Contractor.

6.9 Army Environmental Database and Environmental Restoration Information System

Once a site identified in this PWS has completed the RFI (i.e., appropriate documentation is finalized), the Contractor shall be responsible for providing the COR with the data and documentation necessary for each site in the Army Environmental Database - Restoration Module (AEDB-R). In addition, the Contractor shall upload all generated analytical data into the Environmental Restoration Information System (ERIS) on a quarterly basis. The Army, through the COR, will provide data specifications for AEDB-R and ERIS to the Contractor. The Contractor shall comply with all applicable requirements for data validation and submission.

6.10 Additional Site Plans

Prior to beginning any field work, the Contractor shall prepare any additional plans or documents (e.g., sampling and analysis plans, quality assurance project plan, waste minimization plans, health and safety plans) consistent with **Section C** of the basic contract, the applicable regulatory drivers listed in **Section 2.0** of this Task Order, and any other agreements, orders, or regulations that apply to the Installation and sites. These plans and documents shall be subject to Army review and approval, through the COR.

6.11 Waste Minimization Plans

The Contractor shall provide, and upon Army approval through the COR, implement a Waste Minimization Plan. A Draft and Final Waste Minimization Plan shall be submitted with the PMP deliverables in accordance with **Table 1**. The plan shall identify waste streams and projected volumes to be generated to achieve the performance objectives identified in the PWS.

6.12 Protection of Property

It will not be necessary to access property outside the control of the Army; however, if requirements change and the Contractor determines that a right of entry (ROE) will be needed for any reason, the Contractor will submit a written request to the COR a minimum of 60 calendar days in advance of the proposed entry date stating that a ROE will be needed. The government will procure all ROE. The Contractor will not enter any property not under the control of the Army without an approved ROE and will be required to comply with all conditions specified in the ROE, if required.

The Contractor shall be responsible for any damage caused to property of the United States (Federal property) by the activities of the Contractor or its subcontractors under this contract and shall exercise due diligence in the protection of all property located on the premises against fire or other damage from any and all other causes. Any property of the United States damaged or destroyed by the Contractor or its subcontractors incident to the exercise of the privileges herein granted shall be promptly repaired or replaced by the Contractor to a condition satisfactory to the COR or reimbursement is made by the Contractor sufficient to restore or replace the property to a condition satisfactory to the COR in accordance with FAR Clause 52.245-2.

6.13 Project Stakeholders

For the purposes of this PWS, project stakeholders will include but are not limited to:

- the Army;
- the Georgia Environmental Protection Division;
- the U.S. Environmental Protection Agency (USEPA) Region IV;

Specific Army stakeholders include the following: Installation staffs, Installation Management Command (IMCOM) as the Installation’s parent organization, Department of Defense Explosives Safety Board (DDESB), US Army Technical Center for Explosive Safety (USATCES), US Army Public Health Command, US Army Environmental Command, and US Army Corps of Engineers –Baltimore and Savannah Districts.

The Contractor will be responsible for obtaining comments with appropriate approval on project deliverables consistent with applicable regulatory drivers and agreements for each site. An example of typical review periods for GAPED has been include in the data CD provided as part of this RFP.

6.14 Regulatory Involvement

All regulatory coordination shall be approved by the Army through the COR. The Contractor shall provide the necessary support to initiate, schedule, and address all regulatory aspects of the project (e.g., organizing discussions with regulators concerning site response objectives and completion requirements, obtaining regulator comments on site documents and appropriately addressing them, preparing telecon and meeting minutes and obtaining written documentation of remediation completion from the regulators for all of the sites identified in this PWS). The COR, or designee, will attend and represent the Army at all meetings with the regulators. With approval of the COR, the contractor may also informally discuss remediation issues with regulators and provide an after-action report back to the COR. The Army will be the signature authority for all regulatory agreements and remediation documentation.

6.15 Public Involvement

All public participation coordination shall be approved by the Army through the COR. The Contractor shall provide the necessary support to initiate, schedule, and address all public participation aspects of the project (e.g., preparation of briefings, presentations, fact sheets, newsletters, and articles/public notices to news media). The Contractor shall be responsible for requesting and addressing all public comments consistent with the applicable regulatory drivers listed in **Section 2.0** of this PWS. The COR, or designee, will attend and represent the Army at all meetings with the public.

In 2010, Fort Stewart solicited the community to determine if there was interest in establishing a RAB. Fort Stewart did not receive sufficient community interest to warrant establishment of a RAB. Should a RAB be established in the future, the contractor will be required to provide the necessary support (e.g., preparation of briefings, presentations, fact sheets, newsletters, and notifications to RAB members) for the sites listed in this PWS. Fort Stewart has a Community Involvement Plan (CIP) that was published in 2007. The contractor will be required to update the CIP, as required, for the sites listed in this PWS.

6.16 Communications

The Contractor shall not make available or publicly disclose any data or report generated under this contract unless specifically authorized by the KO through the COR. If any person or entity requests information from the Contractor about the subject of this performance work statement or work being conducted hereunder, the Contractor shall refer them to the COR. All reports and other information generated under this scope of work shall become the property of the Government, and distribution to any other source by the Contractor is prohibited unless authorized by the KO.

6.17 Deliverable Requirements

All documents must be produced in draft, draft-final, and final versions in both hard copy and electronic (PDF) format. The electronic format must have optical character recognition per the USAEC READ requirements. The Contractor will provide a sufficient number of copies of each submittal as requested by the various project stakeholders. The COR will provide consolidated Army comments on preliminary-draft documents to the Contractor within thirty (30) business days. Once initial comments are addressed, the Army will review draft-final documents before submission to appropriate regulatory agencies. The Contractor shall ensure that review periods are consistent with the applicable regulatory drivers noted in **Section 2** of this PWS. All documents shall be identified as draft-final until completion of stakeholder coordination, when they will be signed and finalized. One copy of the final document shall be placed in both the project repository and Administrative Record (for CERCLA documents).

The Contractor will conform to US Army Corp of Engineers (USACE) requirements or a similar approach that addresses all subject matter areas prescribed in the USACE requirements, which can be found at: http://www.hnd.usace.army.mil/oew/CX_refdocs.aspx and http://140.194.76.129/publications/. The most recent version of these references at the time of task order award will apply.

The Munitions Response Site Prioritization Protocol (MRSPP) requirements in 32 CFR Section 179 require the DOD in consultation with representatives of the states and Indian tribes, to assign each MRS a relative priority for response actions. The initial MRSPP score for MRSs is developed during the CS phase. These MRSPP scores must be reviewed annually and must be revised whenever new data are obtained. Pursuant to this requirement, the Contractor shall annually review, revise MRSPP scores based on new information, and submit to the Army. In addition, the Contractor shall also include any information that may have influenced the MRS priority or MRS sequencing decision in the Administrative Record and the Information Repository. Furthermore, the FY02 Defense Authorization Act creating the MMRP requires DOD to develop and maintain an inventory of defense sites that are known or suspected to contain UXO, DMM or MC. Pursuant to this requirement, the Contractor shall submit annual updates to the Installation Munitions Response (MR) map that reflect changes to the location, boundaries and/or extent of all Fort Stewart MMRP sites in .pdf format. ***Note that these two annual deliverables will not be accepted as interim payment milestones.***

The Contractor shall propose deliverables and payment milestones as part of its proposal, and if approved by the Army, included as part of the PMP. Final decisions regarding the adequacy of milestone and deliverable completion resides with the COR (see ***Section 5.2***, *Milestone Presentations*) and will be based on the appropriate acceptance and approval of required documentation by the Army and Regulatory Agencies, consistent with RCRA and the NCP.

6.18 Geographic Information System

The Contractor shall adhere to all applicable federal, DoD, and Army geospatial data standards for tasks and deliverables in this PWS. Spatial data must in a personal geodatabase format that is compliant with the Spatial Data Standards for Facilities, Infrastructure, and Environment v2.6. Spatial data must meet the requirements of the associated Quality Assurance Plan (QAP). If no QAP exists for the data layers developed, the Contractor shall meet the minimum requirements listed in **Attachment E**. Each geospatial data set shall be accompanied by metadata conforming to the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) and the Army Installation Geospatial Information & Services (IGI&S) Metadata Standard, v1. The horizontal accuracy of any geospatial data created by the contractor shall be tested and reported in accordance with the National Standard for Spatial Data Accuracy

(NSSDA) and the results shall be recorded in the metadata. All data must have a datum of WGS84 and a projection of Universal Transverse Mercator (UTM) Zone 17N. Army technical experts will independently review Contractor work to ensure compliance with all spatial data requirements. Installation subject matter experts will review Contractor work and validate geospatial data. Validated data will be submitted to the Army Mapper database by the contractor.

Any data with a vertical component must be referenced to the North American Vertical Datum of 1988 (NAVD88). The spatial reference must have a precision of 1000.

7.0 Expertise and Necessary Personnel

The Contractor shall provide the necessary personnel and equipment to execute this PWS successfully. The Contractor is responsible for determining the requirements for licensed professionals and certifications.

The Contractor shall furnish all plant, labor, materials and equipment necessary to meet the performance objectives. The Contractor shall provide personnel trained as required by the Occupational Safety and Health Administration (OSHA) and all other applicable federal and state regulations. The Contractor shall provide all support activities necessary to ensure the safe and effective accomplishment of all work. For all work performed under this contract, the Contractor shall also develop and implement quality control measures consistent with all applicable federal and state regulatory requirements and standards.

7.1 Key Personnel

The Army requires that the following positions, at a minimum, be designated as “key personnel”, subject to the terms and conditions for such set forth in the basic contract. The Contractor will notify the COR of any changes in key personnel. The change of key personnel is subject to approval by the KO, although such approval will not be unreasonably withheld provided replacement personnel are of the same quality as originally proposed.

POSITION PERSONNEL
Program Manager – Steve Moran
Project Manager Alex Smith
Senior Geophysicist Jeremy Flemmer
Senior UXO Supervisor Dave COE
UXO Safety Officer Charlie Hutchinson
UXO Quality Control Officer Charlie Hutchinson

8.0 Additional Requirements

8.1 Resources

8.1.1 Army Furnished Resources

The Army will provide the following resources to the Contractor:

- Access to Army-maintained records, reports, data, analyses, and information, in their current format (e.g., paper copy, electronic, tape, disks, CDs), as related to the MMRP Munitions Response Sites (MRSs).
- Access to DOD and Army policy and guidance documents.
- Evacuations, compensation, and temporary housing for displaced residents during intrusive activities and MEC destruction will be the responsibility of the Government.
- All Army owned property used for Remedial Facility Investigation purposes must be maintained by the Contractor in accordance with applicable maintenance requirements, and may not be replaced by the Army should new equipment be required.
- GIS database resources from the MMRP CS Reports will be provided by the COR following task order award.
- Access to personnel to conduct interviews on Installation operations and activities.
- All ROEs will be executed by a Government Real Property Officer.

8.1.2 Contractor Furnished Resources

The Contractor will be responsible for providing the following:

- Coordination with the Army and the Installation in order to get access to the Installation, as required for execution of this PWS and by doing so, will follow the procedures described during the Contractors' meeting at the Installation.
- Coordination with the Army and the Installation in order to gain access to available infrastructure (e.g., buildings, roadways, waste management units, other Installation facilities) and utilities (e.g., electric power and telephone lines, natural gas and water supply distribution pipelines, and wastewater discharge conveyances), as required for execution of this PWS.
- The contractor is responsible for disposal of all investigation derived waste generated under this contract including removal and disposal of munitions related debris, detonation and disposal of MEC.
- Site air monitoring for hazardous chemicals during intrusive activities.
- Any munitions debris or scrap found will be collected, managed and properly disposed following Installation requirements.
- Any other necessary resources needed to achieve the defined performance objectives of this PWS.

8.2 Certification and Approval of Project Milestones and Deliverables

The COR will perform contract management, inspection, oversight, review, and approval activities. Certification and approval of project milestones by the COR is necessary before distribution of financing payments. Certification by the Army is also contingent upon the Contractor performing in accordance with the terms and conditions of the contract for this work, this PWS, and all amendments.

Representatives of the Army and the Contractor will have a conference with the COR in a manner and at a time agreed to by all parties after receipt of each status report to:

- Formally review the quantity and quality of services;
- Inspect work for compliance with this PWS, the associated Contractor's final proposal, and project documentation;
- Accept or reject milestones and deliverables completed since the previous review; and
- Prepare, approve and submit DD Form 250 “Material Inspection and Receiving Report” for financing payments in accordance with milestone completions and approvals to the COR.

8.3 Government Rights

The Army has unlimited rights to all documents/material produced under this contract. All documents and materials, to include the source codes of any software, produced under this contract shall be Army owned and are property of the Army with all rights and privileges of ownership/copyright belonging exclusively to the Army. These documents and materials cannot be used or sold by the Contractor without written permission from the KO. All materials supplied to the Army shall be the sole property of the Army and cannot be used for any other purpose. This right does not abrogate any other Army rights under the applicable Data Rights clauses.

8.4 Stop Work

Government personnel have the authority and responsibility to stop work immediately if the work is considered to be a serious threat to the safety or health of workers, other personnel, or to the environment. Authorized Government personnel include, but are not limited to, Government OE Safety Specialists, Installation safety officers, Installation Environmental Division personnel, and command personnel with responsibility for overall Installation operations. When work is stopped due to a hazard/threat to worker safety, health, or the environment, the situation and resolution must be documented and submitted to the KO. Work must be stopped whenever chemical and biological warfare agents or radiological materials are discovered. In addition, the KO has the authority to temporarily stop work on a project following a 24-hour (one working day) written notification to the Contractor. Stop work notices may be related to nonconformance to project specifications, lack of performance by the Contractor, financial considerations, funding considerations, and other circumstances outlined in the contract. Stop work notices may also be related to security levels that could prevent access to the Installation during a time of national crisis.

8.5 Environmental Responsibility Considerations

The Army will retain responsibility for any assessed natural resource damages that are attributed to historic releases of hazardous substances (prior to contract with the Contractor) and any injuries that are necessary and incidental to the reasonable implementation of a selected response or remedial action. The Contractor shall be responsible for any/all additional natural resource injuries and associated natural resource damages claims brought as a result of its actions (e.g. release of hazardous substance or unreasonable disturbance of natural resources as a result of construction activities).

The Army will retain all responsibility for third party liability for CWM or radiological material that are either targeted for or may be discovered during the course of remediation. Response cost claims, property damage and personal injury claims brought due to contamination and hazardous substance releases that have occurred historically (prior to contract with the Contractor) and are not due to Contractor remediation activities are excluded from Contractor responsibility. The Contractor shall be responsible for and indemnify the Army for:

- Any response cost claims for any environmental remediation services which the Contractor has assumed responsibility for under this PWS;
- All costs associated with correction of a failure of any remedy implemented or operated and maintained by the Contractor to the extent such failure was caused by the willful or negligent acts or omissions of the Contractor in the course of performing the environmental services;
- All personal injury or property damage claims to the extent caused by the acts or omissions of the Contractor in the course of performing the environmental services;
- All natural resource damages pursuant to 42 U.S.C. Section 9607(a)(4)(C), to the extent that such damages were caused or contributed to by the actions of the Contractor or its successors in interest; and
- All costs associated with or arising from any negligent acts or omissions or willful misconduct of the Contractor in the course of performing the environmental services or implementing remedial actions.

8.6 Inspections

The Army technical experts will independently review Contractor work to ensure compliance with all applicable requirements.

Any service or submittal performed that does not meet Task Order requirements shall be corrected or re-performed by the Contractor and at no additional cost to the Government. Corrective action must be certified and approved by the COR. If the contractor performs any task unsatisfactorily and all defects are not corrected, the Government reserves the right to terminate the Task Order for default. In addition, the Government reserves the rights under FAR clause 52.246-4, Inspection of Services – Fixed Price, for further remedies concerning a Contractor’s failure to perform in conformance with contract requirements.

8.7 Organizational Conflicts of Interest

8.7.1 Disclosure.

The Contractor shall provide a disclosure statement with its proposal, which concisely describes all relevant facts concerning any past or present organizational conflicts of interest relating to the work in each PWS. In the same statement, the Contractor shall provide the information required in the following paragraph to assure the Government that the conflicts of interest have been mitigated and/or neutralized to the maximum extent possible. If a conflict of interest is discovered after contract award, the Contracting Officer will make a decision whether to terminate or rescind the PWS and/or contract at that time.

8.7.2 Potential Conflicts of Interest.

This request for proposals is open to any offeror to compete as a prime contractor, subcontractor or in any teaming arrangement. In order to avoid any organizational conflicts of interest, or even the appearance of any organizational conflicts of interest, any contractor performing environmental services work at the follow-on installation(s) under each contract will need to avoid, neutralize and/or mitigate - prior to contract award - significant potential conflicts of interest that may prejudice effective competition. The KO has determined that at a minimum contractors currently performing work on the identified installation(s) under each contract must ensure that all data pertaining to contamination at the sites compiled by or in the possession of such contractors shall be made available to all potential contractors in a timely fashion to the maximum extent possible by providing such data in to a data depository.

8.8 Access and Security

In order to ensure the security and orderly running of the Installation, any contractor personnel who wish to gain access to the Installation shall follow procedures established by the Installation. The Contractor should account for potential delays due to DOD security requirements in its pricing.

The installation is surrounded by security fence and gates. Access will be granted by the installation security office to the contractor for period of performance.

8.9 Travel

Travel to/from the Installation and to other CONUS locations (locations within the continental United States) for such purposes as to attend meetings, briefings and/or presentations may be required incidental to this RFI, the costs for which shall be included in the total price for the PWS.

8.10 Performance and Payment Bonds

In accordance with the base contract, the Contractor:

☒ is NOT required to furnish Performance and Payment Bonds on this PWS.

☐ is required to furnish Performance and Payment Bonds on this PWS in accordance with the following:

8.11 Warranty

In accordance with the base contract, the Contractor:

☒ is NOT required to provide a 5-year warranty for each site as specified in this PWS.

☐ is required to provide a 5-year warranty for each site as specified in this PWS.

8.12 Contractor Manpower Reporting

The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains a secure Army data collection site where the contractor will report ALL contractor manpower (including subcontractor manpower) required for performance of this contract. The contractor is required to completely fill in all the information in the format using the following web address https://cmra.army.mil . The required information includes:

(1) Contracting Office, Contracting Officer, Contracting Officer's Technical Representative;
(2) Contract number, including task and delivery order number;
(3) Beginning and ending dates covered by reporting period;
(4) Contractor name, address, phone number, e-mail address, identity of contractor employee entering data;
(5) Estimated direct labor hours (including sub-contractor);
(6) Estimated direct labor dollars paid this reporting period (including sub-contractor);
(7) Total payments (including subcontractor);
(8) Predominant Federal Service Code (FSC) reflecting services provided by contractor (and separate predominant FSC for each sub-contractor if different);
(9) Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (the Army Requiring Activity is responsible for providing the contractor with its UIC for the purposes of reporting this information);
(10) Locations where contractor and sub-contractors perform the work (specified by zip code in the United States and nearest City, Country, when in an overseas location, using standardized nomenclature provided on website);
(11) Presence of deployment or contingency contract language, and,
(12) Number of contractor and sub-contractor employees deployed in theater this reporting period (by country). As part of its submission, the contractor will also provide the estimated total cost (if any) incurred to comply with this reporting requirement. Reporting period will be the period of performance not to exceed 12 months ending September 30 of each government fiscal year and must be reported by 31 October of each calendar year.

8.13 Monthly Progress Reports

The contractor shall submit by the 10th day of each month a monthly progress report summarizing activities of the preceding month (if at least 15 days of contract performance occurred in that month) and planned activities for the following month. The contractor is required to completely fill in all the information in the format using the following web address https://cmra.army.mil. The report shall be a concise summary and include at a minimum, the following information:

(1) Contracting Office, Contracting Officer, Contracting Officer's Representative;
(2) Contract number, including task and delivery order number;
(3) Beginning and ending dates covered by the report;
(4) Date of the report;
(5) Contract completion date and list of all CLIN period of performance dates;
(6) Contractor name, address, phone number, e-mail address, identity of contractor employee entering data;
(7) Summary of accomplishments for the report month and planned accomplishments for the following month;
(8) Safety reporting including field exposure hours and recordable and/or reportable accidents;
(9) Record of deliverables submitted;
(10) record of communication, correspondence, and invoices;
(11) Estimate of percentage complete for each task and overall percentage complete;
(12) Personnel changes, and,
(13) If applicable an updated network analysis schedule.

Reports shall be submitted to the COR in hard copy as well as via email. Email attachments, if any, shall be in Adobe pdf or MS Word format only. Email submittals shall include the project manager and emdc.admin@usace.army.mil on the cc line. The subject of the email shall be the contract number with task order followed by "Monthly Progress Report" followed by the year and month of the report (for example "W912DR-99-D-9999 9999 Monthly Progress Report YYYY MM").

9.0 Contracting Officer's Representative

Name: Travis McCoun
Organization: USACE- CENAB-EN-HM
Address: 10 S. Howard Street, Room10040-x
City, State, Zip Code: Baltimore, Maryland, 21201
Telephone: 410-962-6728
Email: Travis.McCoun@usace.army.mil

Attachment A: Reference Documents

The Army believes that documentation provided with the solicitation represents the most recent and appropriate documentation available for the Installation and sites identified in this contract. However, if there is a conflict between this information and other site documentation (the existing reports), the Contractor is solely responsible for reviewing all available information and forming their independent, professional conclusions/interpretation of site conditions and requirements to meet the objectives of this contract. This information is not intended as a substitute for complete analysis of technical data available, nor is it intended to be a guide on how the Contractor should address achievement of the performance objectives/standards.

Specific documents may be made available following a request to the Contracting Officer, if the documentation can be distributed in a timely manner. Electronic format is not guaranteed.

Table 2: Available Reference Documents.

Title	Author	Date
Final Closed, Transferring, and Transferred Range/Site Inventory Report, Fort Stewart, Georgia	Malcolm-Pirnie, Inc.	October 2003
Final Historical Records Review, Fort Stewart, Hinesville, GA	Malcolm-Pirnie, Inc.	SEP 2006
FINAL Confirmatory Sampling Report, Fort Stewart, Hinesville, GA	Malcolm-Pirnie, Inc.	NOV 2007
Final – Phase 2 Historical Records Review, Fort Stewart, GA	Malcolm-Pirnie, Inc.	June 2010
Phase 2 Confirmatory Sampling Report, Fort Stewart, Hinesville, Georgia	Arcadis/Malcolm Pirnie, Inc.	September 2012
Phase 2 CS Report, MRS Map	USACE/Malcolm-Pirnie	2010
Final Preliminary Investigation/TCRA for the Small Arm Range Berm Area of MMRP Site FTSW-0006-R-01 Fort Stewart, GA	SES	March 2012
Integrated Cultural Resources Management Plan	J.M. Waller Associates & Bregman and Co.	September 2001
Integrated Natural Resources Management Plan	FSGA/HAAF	July 2005
Final Community Involvement Plan for Fort Stewart and Hunter Army Airfield Installation Remediation Program	Fort Stewart	March 2007
Phase 2 Confirmatory Sampling Report, Fort Stewart, Hinesville, Georgia – GIS Data	Arcadis/Malcolm Pirnie, Inc.	September 2012
MEC Quality Assurance (QA) Investigation to Depth of Detection at Anti-Aircraft Range – 4 MRS (FTSW-009-R-01).	USACE	March 2011
MEC Quality Assurance (QA) Follow-on Investigation to Depth of Detection at Anti-Aircraft Range – 4 MRS (FTSW-009-R-01).	USACE	April/May 2011
Army and Air Force Exchange Service (AFFES) Shoppette Highway 144 Construction Site at Anti-Aircraft Range – 4 MRS (FTSW-009-R-01).	USACE	June 2011

Draft Explosive Siting Plan	USACE	September 2012
Example/Draft QASP	USACE	NA
MEC Hazard Assessment Guidance, Interim	USEPA	October 2008
Final Army MMRP RI/FS Guidance Manual	USAEC/Malcolm-Pirnie	November 2009
RFP Packets for Explosive Safety Tasks	USACE	13 January 2010

Attachment B: List of Acronyms

AEDB-R Army Environmental Database - Restoration
AAFES Army and Air Force Exchange Service
AOC Area of Concern
CA Corrective Action
CAIS Chemical Agent Identification Set
CD Compact Disk
CERCLA Comprehensive Environmental Response, Compensation, and Liability Act
CFR Code of Federal Regulations
CS Confirmatory Sampling
CSDGM Content Standard for Digital Geospatial Metadata
CONUS Continental United States
COR Contracting Officer's Representative
CTT Closed, Transferred, and Transferring
CWM Chemical Warfare Materiel
DDESB Department of Defense Explosives Safety Board
DERP Department Environmental Restoration Program
DMM Discarded Military Munitions
DOD Department of Defense
DPW Department of Public Works
DQO Data Quality Objective
EMS Environmental Management System
EOD Explosive Ordnance Disposal
EP Environmental Publication
ER Environmental Regulation
ERIS Environmental Restoration Information System
ESP Explosive Site Plans
ESS Explosive Safety Submission
FAR Federal Acquisition Regulation
FGDC Federal Geographic Data Committee
PDF Electronic Format (Adobe)
FTSW Fort Stewart
GA Georgia
GAEPD Georgia Environmental Protection Division
GIS Geographic Information System
HRR Historical Records Review
IAP Installation Action Plan
IBCT Infantry Brigade Combat Training
IDW Investigation Derived Waste
IMCOM Installation Management Command
IRA Interim Removal Action
KO Contracting Officer
LTM Long-Term Management

MC Munitions Constituents
MCL Maximum Contaminant Level
MDE Munitions Debris
MDE Maryland Department of the Environment
MEC Munitions and Explosives of Concern
MMRP Military Munitions Response Program
MPPEH Material Posing a Potential Explosive Safety Hazard
MRSPP Munitions Response Site Prioritization Protocol
MM Military Munitions
MR Munitions Response
MRA Munitions Response Area
MRS Munitions Response Site
NAVD88 North American Vertical Datum of 1988
NCP National Oil and Hazardous Substances Contingency Plan
NELAP National Environmental Laboratory Accreditation Program
NSSDA National Standard for Spatial Data Accuracy
NTP Notice to Proceed
OSHA Occupational Safety and Health Administration
p/c Pollutants or Contaminats
PBA Performance-Based Acquisition
PMP Project Management Plan
POC Point of Contact
PPE Personal Protective Equipment
PWS Performance Work Statement
QA Quality Assurance
QAPP Wuality Assurance Project Plan
QASP Quality Assurance Surveillance Plan
QAP Qual;ity Assurance Plan
QIPR Quarterly In Progress Review
QSM Quality Systems Manual
RAB Restoration Advisory Board
RA(O) Remedial Action (Operations)
RC Response Complete
RCRA Resource Conservation and Recovery Act
READ Army Repository of Environmental Documents
RFD Reference Dose
RFI RCRA Facility Investigation
ROE Right of Entry
RIP Remedy In Place
SARA Superfund Amendments and Reauthorization Act
SC Site Close out
SI Site Inspection
SSHP Site Safety and Health Plan
USACE United States Army Corps of Engineers
USAEC United States Army Environmental Center
USATCES U.S. Army Technical Center for Explosives Safety

U.S.C United States Code
USDA United States Department of Agriculture
USEPA United States Environmental Protection Agency
UTM Universal Transverse Mercator
UXO Unexploded Ordnance

Attachment C: Definitions

Activity-Based Schedule: Activities and milestones defined at the detail level and logically sequenced to support, and manage completion of the performance objectives.

Contractor's Project Costs: Costs incurred by the Contractor (including costs covered by insurance and the PMP) in executing the work required to achieve the performance objectives identified in the PWS for all sites identified in this contract/task order.

Chemical Warfare Materiel (CWM): An item configured as a munitions containing a chemical substance that is intended to kill, seriously injure, or incapacitate a person through its physiological effects. CWM also includes V- and G- services nerve agent, H-series blister agent, and lewisite in other than munitions configurations. Due to their hazards, prevalence, and military-unique application, Chemical Agent Identification Sets (CAIS) are also considered CWM. CWM does not include riot control agency, chemical herbicides, smoke and flame producing items, or soil, water, debris, or other media contaminated with chemical agent.

Deliverables: Documentation or data that support the completion of milestones or achievement of the performance objectives identified in this PWS.

Discarded Military Munitions (DMM) – Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

Explosive Ordnance Disposal (EOD) – The detection, identification, on-site evaluation, rendering safe, recovery, and final disposal of unexploded explosive ordnance. It may also include explosive ordnance that has become hazardous by damage or deterioration.
Milestones: Significant events or activities that occur in the course of the Contractor achieving the performance objectives identified in this PWS.

Military Munitions (MM) – All ammunition products and components produced or used by or for the DoD or the U.S. Armed Services for national defense and security, including MM under the control of the DoD, the U.S. Coast Guard, the U.S. Department of Energy, and National Guard personnel. The term military munitions includes: confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DoD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. MM do not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components thereof. However, the term does include non-nuclear components of nuclear devices, managed under DOE’s nuclear weapons program, after all required sanitization operations under the Atomic Energy Act of 1954, as amended, have been completed.

Munitions Constituents (MC): Any materials originating from unexploded ordnance, DMM, or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.

Munitions Debris (MD) – Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarization, or disposal.

Munitions and Explosives of Concern (MEC): This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means UXO, as defined in 10 .SC 101(e)(5)(A) through (C); DMM, as defined in 10 USC 2710(e)(2); or MC (e.g., TNT, RDX), as defined in 10 USC 2710(e)(3), present in high enough concentrations to pose an explosive hazard.
Munitions response – A response action, including investigation, removal actions, and remedial actions, to address the explosives safety, human health, and/or environmental risks presented by munitions and explosives of concern (MEC) and/or MC.

PMP Documents: The original PMP (including project schedule), revisions, and status reports.

Project Documents (CERCLA): Documentation and data required by CERCLA remediation and RA(O) and/or LTM activities. These documents include the additional site plans referenced in **Section 6.0** of this PWS.

Project Price: The approved proposed price for achieving completion of remediation services in accordance with the PWS, the payment of which will be tied to one or more project milestones. The Project Price does not include the cost of the PMP, insurance premiums or surplus line taxes, if applicable.

Project-related information: All previous environmental restoration documentation of a technical nature developed by the Army and previous Army contractors and subcontractors during their work at the sites specified in this PWS, and all the documentation developed by the Contractor in order to achieve the performance objectives specified in this PWS.

Site Close-Out: Site Close-Out signifies when the Army has completed active management and monitoring at an environmental cleanup site, no additional environmental cleanup funds will be expended at the site and the Army has obtained regulator concurrence. For practical purposes, Site Close-Out occurs when cleanup goals have been achieved that allow unrestricted use of the property (i.e., no further LTM, including institutional controls, is required). Site Close-Out may include, but not be limited to, the dismantling, removal, recycling, reclamation and/or disposal of all remedial activity systems and ancillary equipment above and underground to return the site to its natural state.

*Unexploded ordnance (UXO)***:** Military munitions that have been primed, fuzed, armed, or otherwise prepared for action; have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and remain unexploded either by malfunction, design, or any other cause.

Attachment D: Points of Contact

Kathryn Brown
USACE Contracting Officer (KO)
Baltimore District Corps of Engineers
ATTN: CENAB-CT
10 South Howard Street
Baltimore, MD 21201-1715
410-962-2585
Kathryn.E.Brown@usace.army.mil

Travis R. McCoun, P.G.
USACE Contracting Officer's Representative (COR)
ATTN: CENAB-EN-HM
10 South Howard Street RM 10000-B
Baltimore, MD 21201-1715
410-962-6728
Travis.McCoun@usace.army.mil

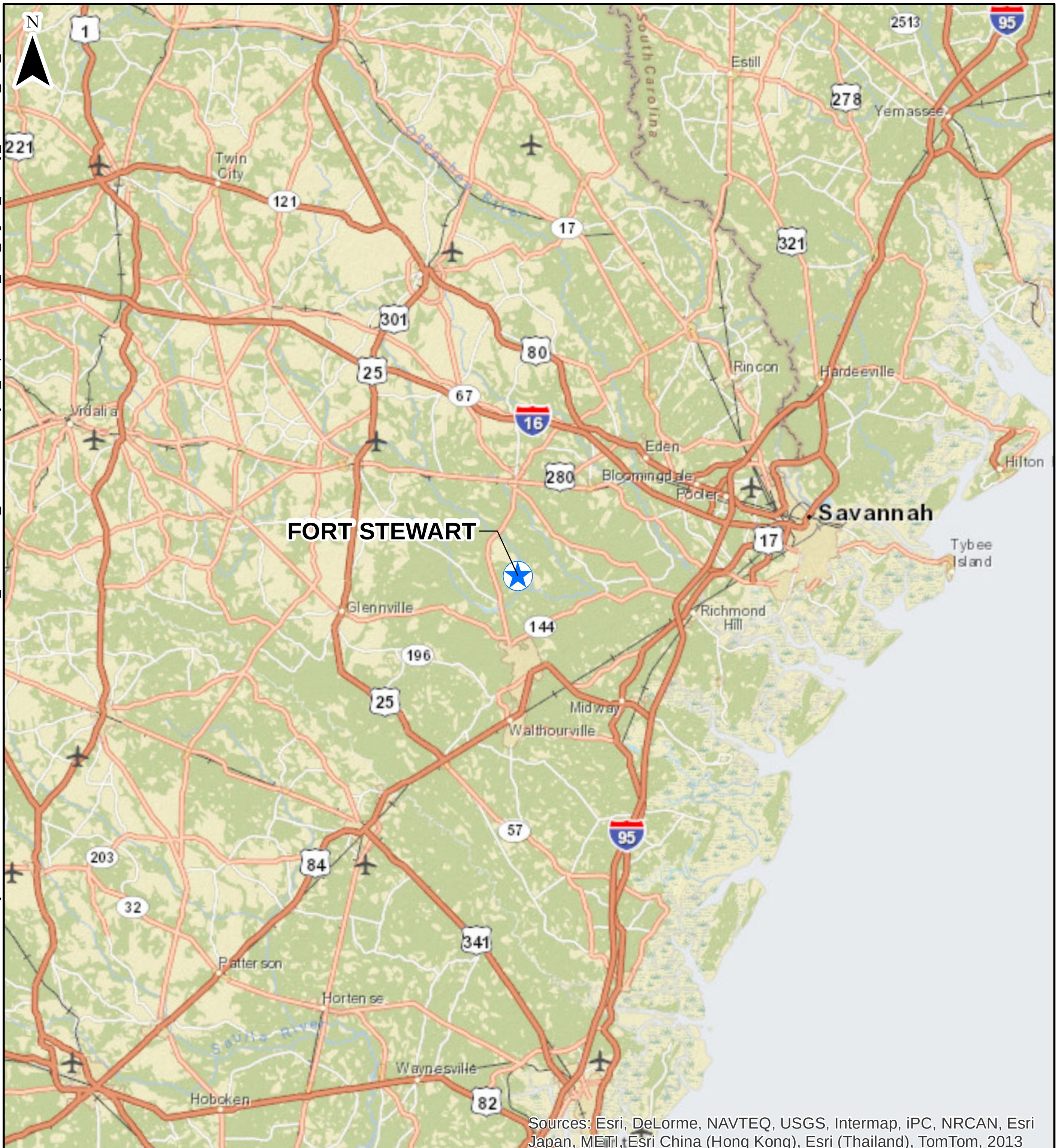
Contracting Specialists:
La Shura Johnson
Contract Specialist
Baltimore District Corps of Engineers
ATTN: CENAB-CT
10 South Howard Street, Rm. 7000
Baltimore, MD 21201-1715
410-962-5626
LaShura.M.Johnson@usace.army.mil

Attachment E: MINIMUM REQUIREMENTS FOR DATA LAYERS WITHOUT AN ESTABLISHED QUALITY ASSURANCE PLAN

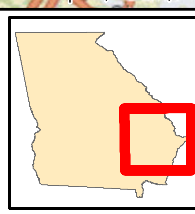
- Installation geospatial data shall be provided in a personal geodatabase compliant with the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE), version 2.6
- If a geospatial data layer contains a discriminator per SDSFIE v2.6, the discriminator must be Populated
- All features shall be attributed with the Installation Code from the Headquarters Installation Information System (HQIIS)
- Each data layer shall be accompanied by metadata conforming to the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) and the Army Metadata Standard
- The FGDC National Standard for Spatial Data Accuracy (NSSDA) shall be used to evaluate and report the positional accuracy of all data layers submitted
- All data shall be provided with a defined projection and must have a datum of WGS84
- All data shall be topologically sound and geometrically correct. This includes no null or empty features, no non-simple features and no duplicate features.
- All data shall meet the basic topology rule set for installation geospatial data. Exceptions to the topology rules are possible. In case of an exception, a justification must be provided in the data layer documentation.
- Point features
  - Must be located inside polygons of parent feature class
- Line features
  - Must not self overlap
  - Must not self intersect
  - Must be single part
  - Must not have pseudo-nodes
  - Must not have dangles
- Polygon features
  - Must not overlap
  - Must not have gaps

(End of Summary of Changes)

Appendix B
Figures



Fort Stewart Location



0 15 30 Miles

Projection : NAD_1983_UTM_Zone_16N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

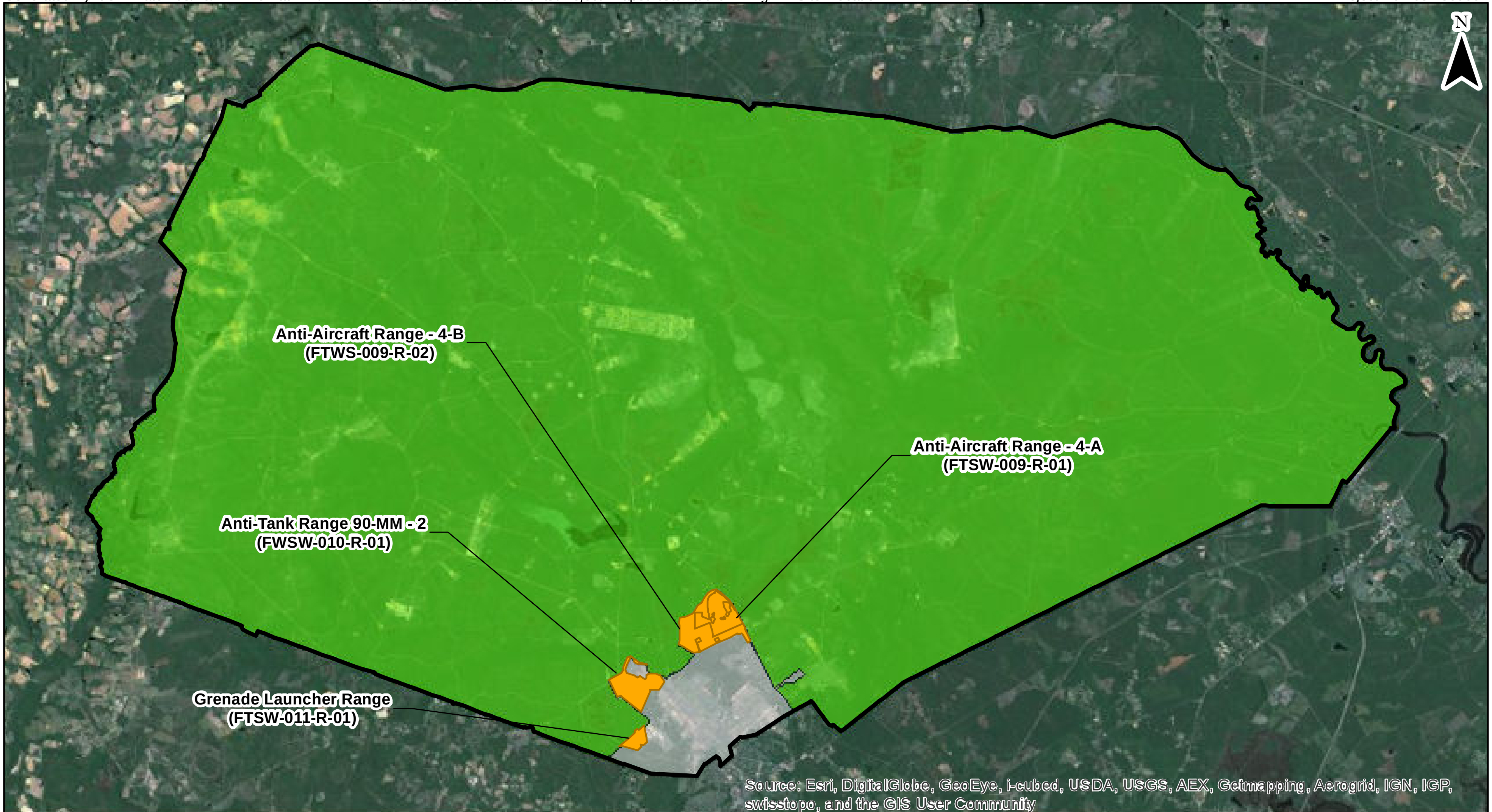
MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-1

FORT STEWART LOCATION
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Project Number: 500064 Generated By: JCP Date: 03/26/14 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_020_Fig1-1_Facility_Location_RFI_WP.mxd



Munitions Response Site

Fort Stewart Installation Boundary

Installation Data

Other than Operational Area

Operational Area

0 20,000 40,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY
CORPS OF ENGINEERS
BALTIMORE DISTRICT

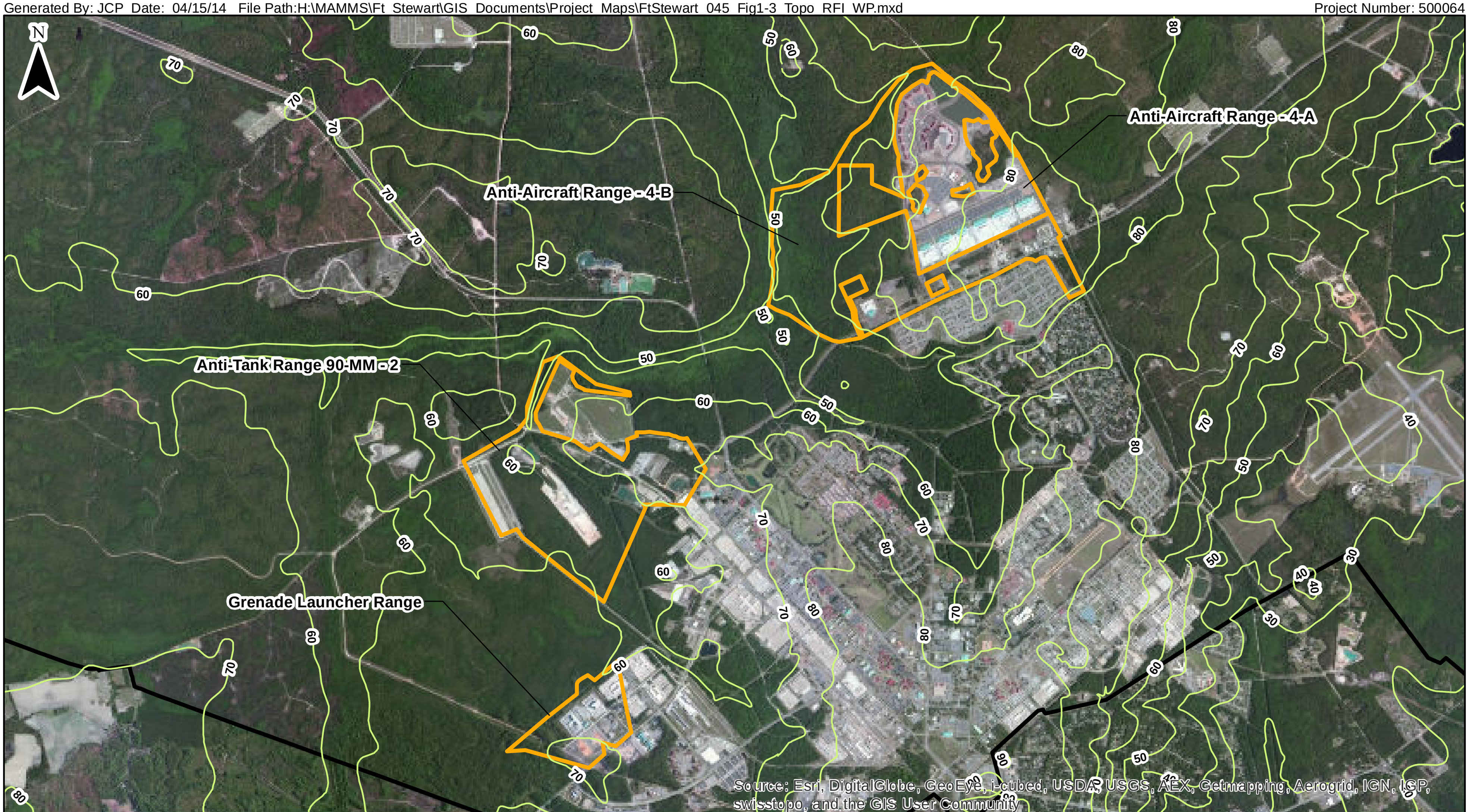
MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-2

MUNITIONS REPONSE SITES
SITE LOCATION
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Generated By: JCP Date: 04/15/14 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_045_Fig1-3_Topo_RFI_WP.mxd Project Number: 500064



Ground Surface Contour (10-Foot Interval)

Munitions Response Site Boundary

Fort Stewart Installation Boundary

Note:
1) Ground surface contour data was obtained from the U.S. Geological Survey (USGS).

0 4,500 9,000 Feet

Projection : WGS_1984_UTM_Zone_17N

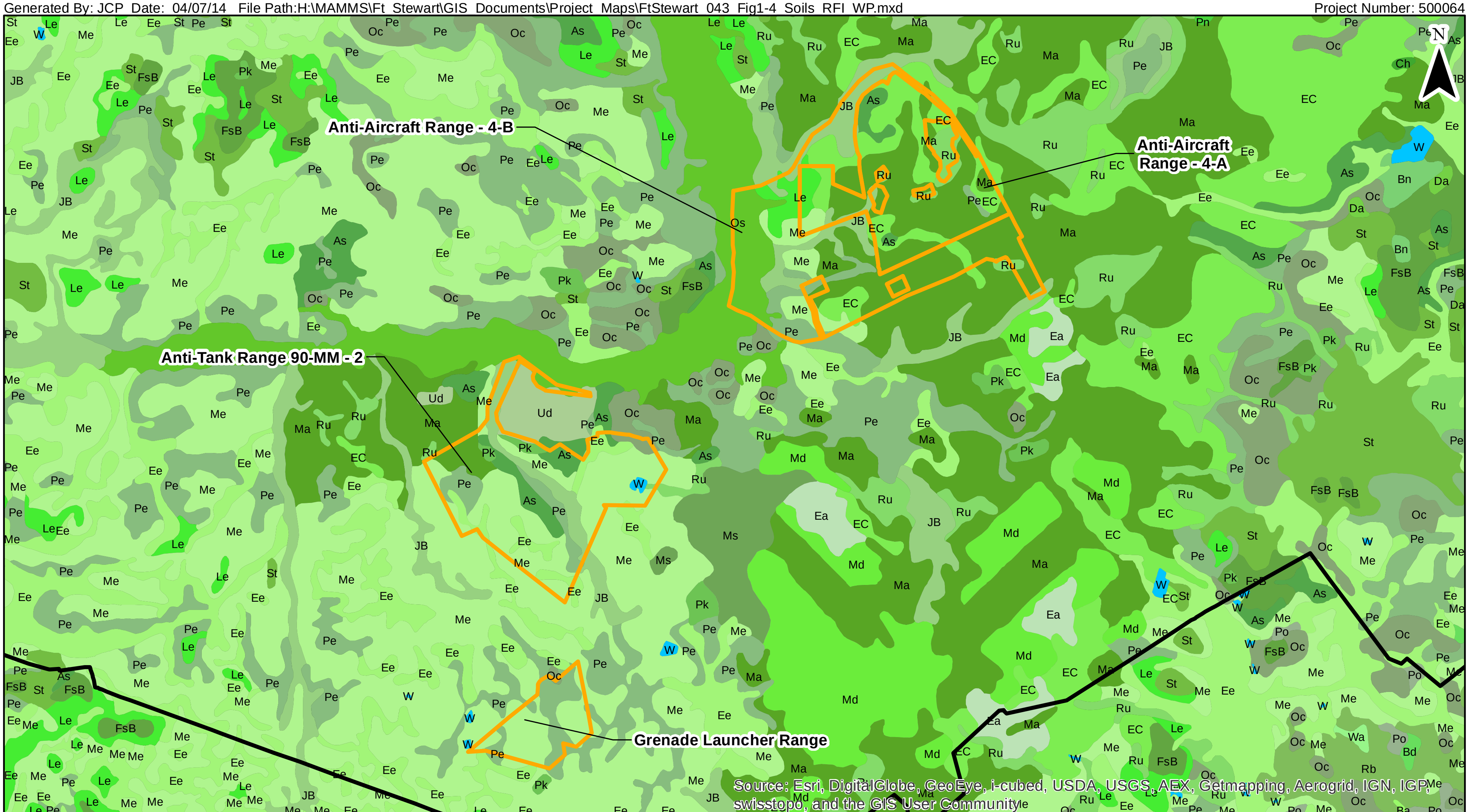
U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-3

TOPOGRAPHY
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017



Munitions Response Site Boundary

Fort Stewart Installation Boundary

Note:
1) Soils data set was obtained from the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS).

0 4,500 9,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-4

USDA SOILS MAP
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Soil Map Unit Boundary

- As - Albany loamy fine sand, 0 to 2 percent slopes
- Ba - Bayboro loam
- Bd - Bladen fine sandy loam
- Bn - Blanton sand, 0 to 3 percent slopes
- Ca - Cape Fear fine sandy loam
- Ch - Chipley sand, 0 to 4 percent slopes
- Da - Dothan loamy sand, 0 to 2 percent slopes
- EC - Echaw and Centenary fine sands
- Ea - Echaw-Urban land complex
- Ee - Ellabelle loamy sand
- FsB - Fuquay loamy sand, 0 to 5 percent slopes
- JB - Johnston and Bibb soils
- Le - Leefield loamy sand
- Ma - Mandarin fine sand, 0 to 2 percent slopes
- Md - Mandarin-Urban land complex
- Me - Mascotte fine sand
- Ms - Mascotte-Urban land complex
- Oc - Ocilla loamy fine sand
- Os - Osier and Bibb soils
- Pe - Pelham loamy sand
- Pk - Pits
- Pn - Ponzer muck
- Po - Pooler fine sandy loam
- Rb - Riceboro loamy fine sand
- Ru - Rutlege fine sand
- St - Stilson loamy sand
- Ud - Udorthents, sandy and clayey
- Wa - Wahee sandy loam
- W - Water

Note:
1) Soils data set was obtained from the U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS).

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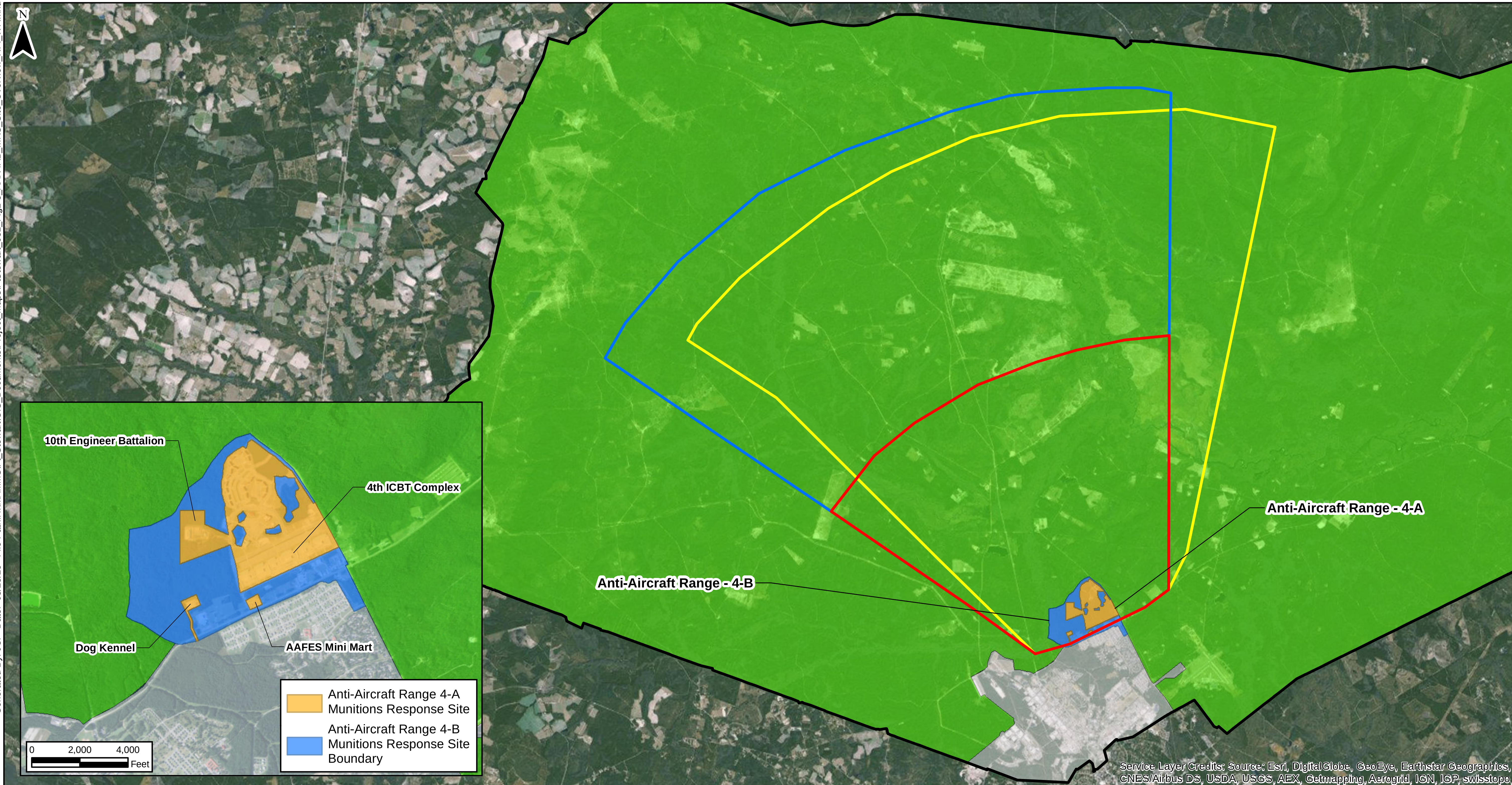
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-4a

USDA SOILS MAP LEGEND
FORT STEWART, GEORGIA

Shaw Environmental & Infrastructure, Inc.
(A CB&I Company)
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017



Fort Stewart Installation Boundary

Historical Range Fans

40-mm Anti-Aircraft (C 40-mm 11850 YRDS) 1941

90-mm Anti-Aircraft (C 90-mm 20500 YRDS) 1941

90-mm Anti-Aircraft (C Range) 1957, 1962, 1964

Anti-Aircraft Range 4-A Munitions Response Site

Anti-Aircraft Range 4-B Munitions Response Site

Installation Data

Other than Operational Area

Operational Area

0 12,000 24,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-5

ANTI-AIRCRAFT RANGE 4 MUNITIONS RESPONSE SITE OVERVIEW FORT STEWART, GA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Generated By: JCP Date: 08/28/15 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_031_Fig1-5_AAR4AB_MRS_Site_Overview_RFI_WP.mxd

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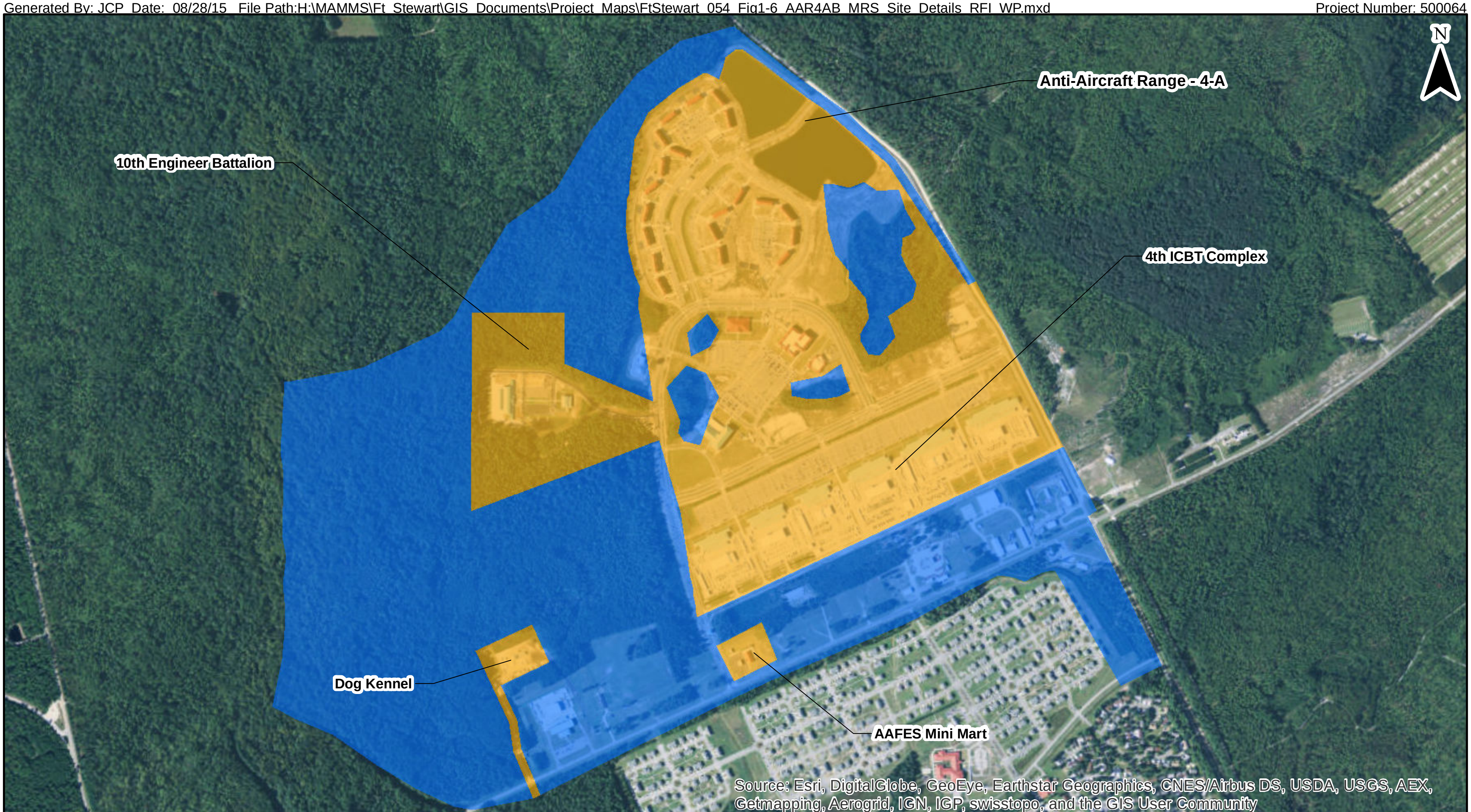


Anti-Aircraft Range 4-A Munitions Response Site

Anti-Aircraft Range 4-B Munitions Response Site

0 1,600 3,200 Feet

Projection : WGS_1984_UTM_Zone_17N

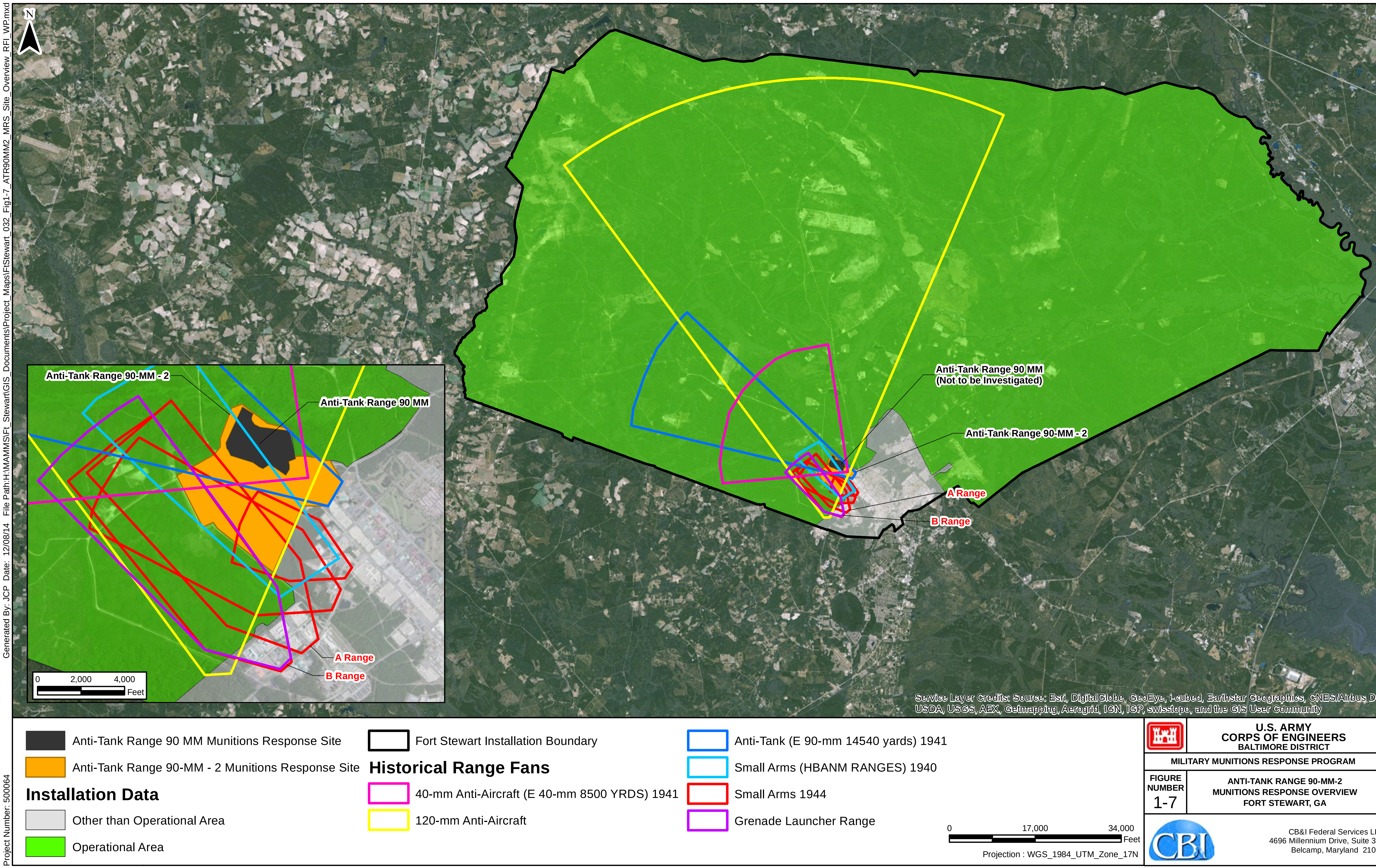
U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-6

ANTI-AIRCRAFT RANGE 4 MUNITIONS RESPONSE SITE DETAILS FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017


N
Anti-Tank Range 90 MM
(Not to be Investigated)
Anti-Tank Range 90-MM - 2
A Range
B Range
Anti-Tank Range 90-MM - 2
Anti-Tank Range 90 MM
A Range
B Range
0 2,000 4,000
Feet
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Anti-Tank Range 90 MM Munitions Response Site
Anti-Tank Range 90-MM - 2 Munitions Response Site
Installation Data
Other than Operational Area
Operational Area
Fort Stewart Installation Boundary
Historical Range Fans
40-mm Anti-Aircraft (E 40-mm 8500 YRDS) 1941
120-mm Anti-Aircraft
Anti-Tank (E 90-mm 14540 yards) 1941
Small Arms (HBANM RANGES) 1940
Small Arms 1944
Grenade Launcher Range
0 17,000 34,000
Feet
Projection : WGS_1984_UTM_Zone_17N
U.S. ARMY
CORPS OF ENGINEERS
BALTIMORE DISTRICT
MILITARY MUNITIONS RESPONSE PROGRAM
FIGURE NUMBER
1-7
ANTI-TANK RANGE 90-MM-2
MUNITIONS RESPONSE OVERVIEW
FORT STEWART, GA
CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017
Generated By: JCP Date: 12/08/14 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_032_Fig1-7_ATR90MM2_MRS_Site_Overview_RFI_WP.mxd
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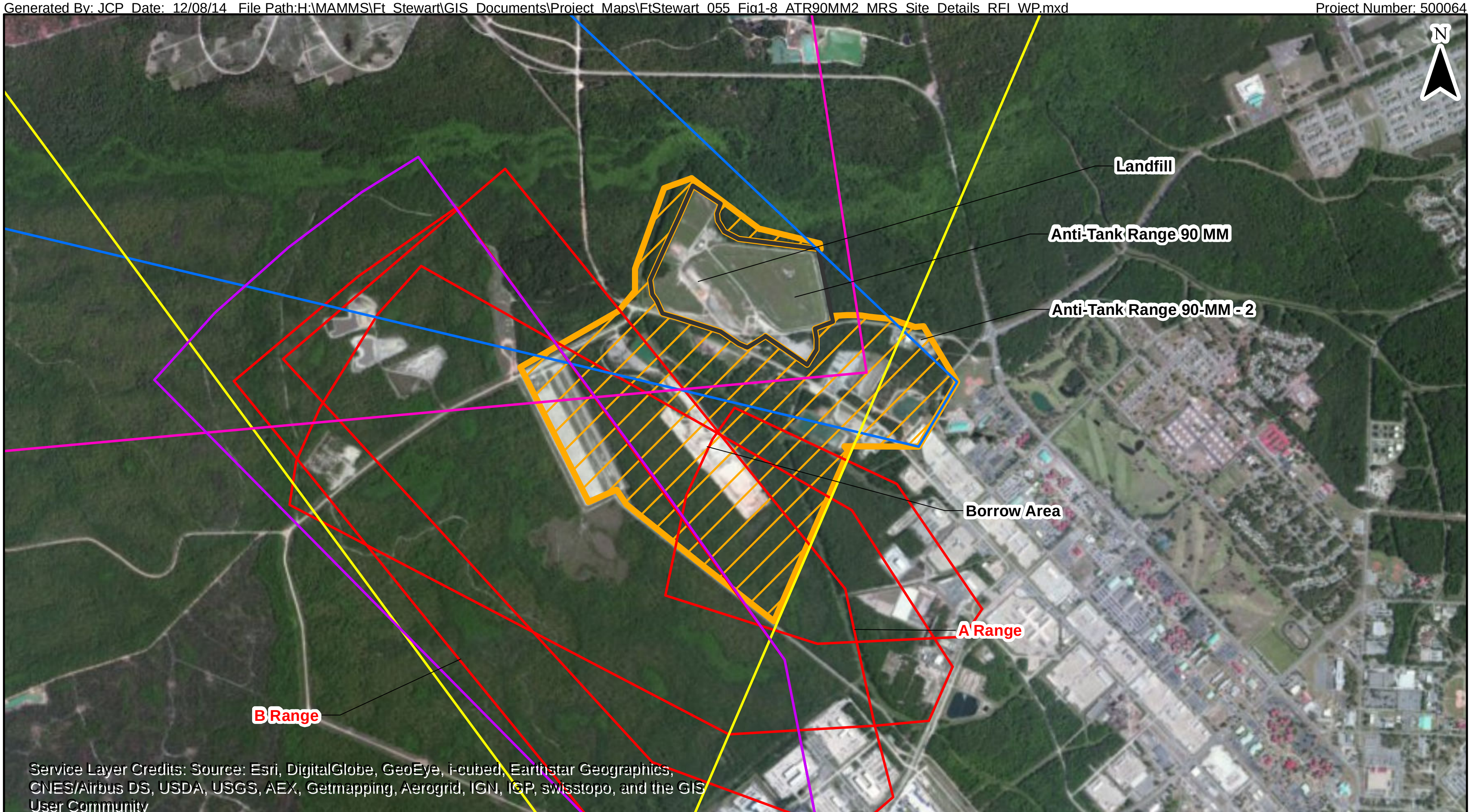
Project Number: 500064



Anti-Tank Range 90 MM Munitions Response Site

Anti-Tank Range 90-MM - 2 Munitions Response Site

Historical Range Fans

40-mm Anti-Aircraft (E 40-mm 8500 YRDS) 1941

Anti-Tank (E 90-mm 14540 yards) 1941

Grenade Launcher Range

120-mm Anti-Aircraft

Small Arms 1944

0 2,500 5,000 Feet

Projection : WGS_1984_UTM_Zone_17N

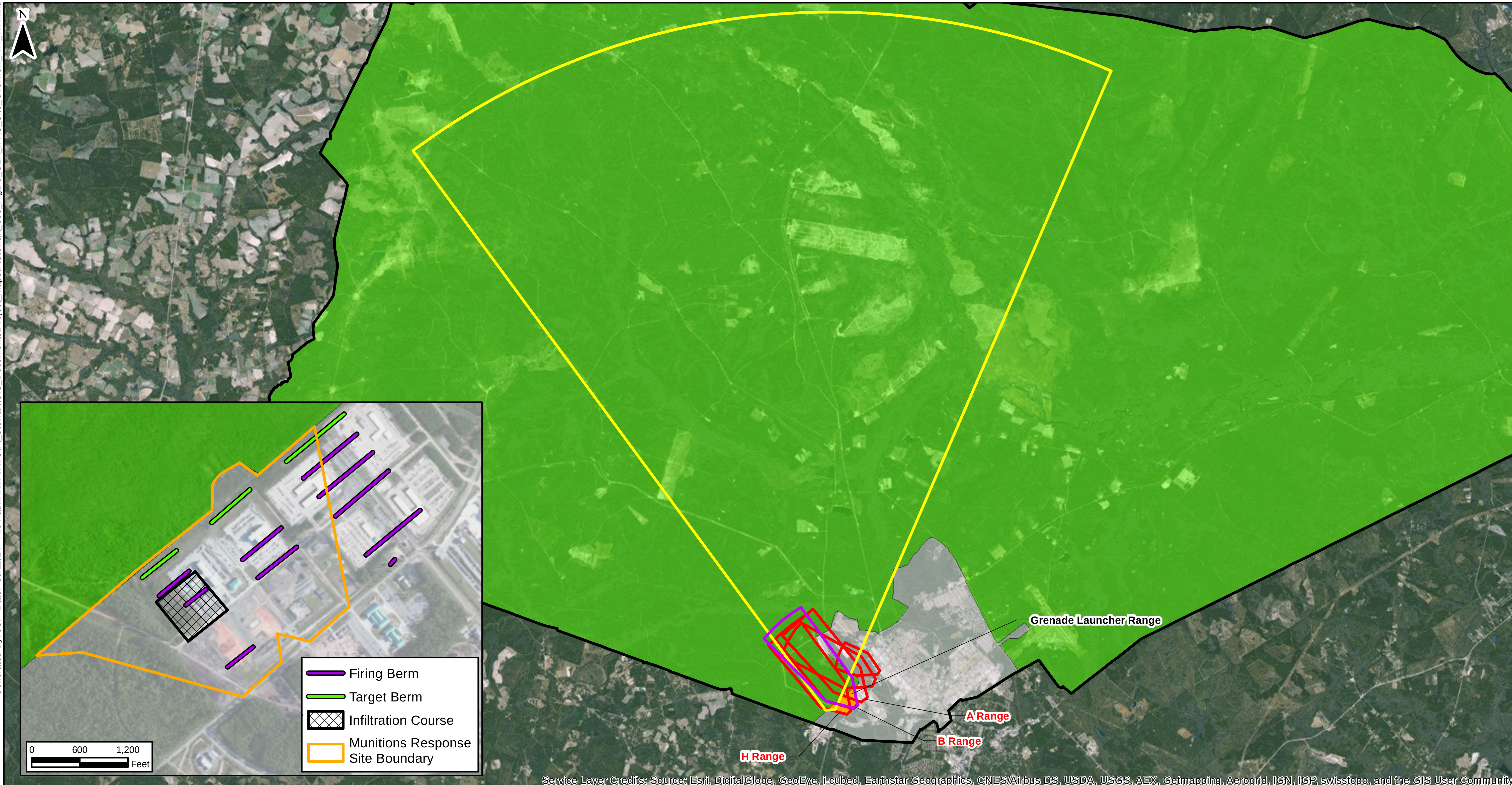
U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-8

ANTI-TANK RANGE 90-MM-2 LANDFILL AREA MUNITIONS RESPONSE SITE DETAILS FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017



Historical Range Fans

- 120-mm Anti-Aircraft
- Small Arms 1944
- Grenade Launcher Range

- Fort Stewart Installation Boundary
- Munitions Response Site

Installation Data

- Other than Operational Area
- Operational Area

0 12,000 24,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY
CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-9

GRENADE LAUNCHER RANGE
MUNITIONS RESPONSE SITE OVERVIEW
FORT STEWART, GA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Generated By: JCP Date: 09/11/14 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_033_Fig1-9_GLR_MRS_Site_Overview_RFI_WP.mxd

Project Number: 500064

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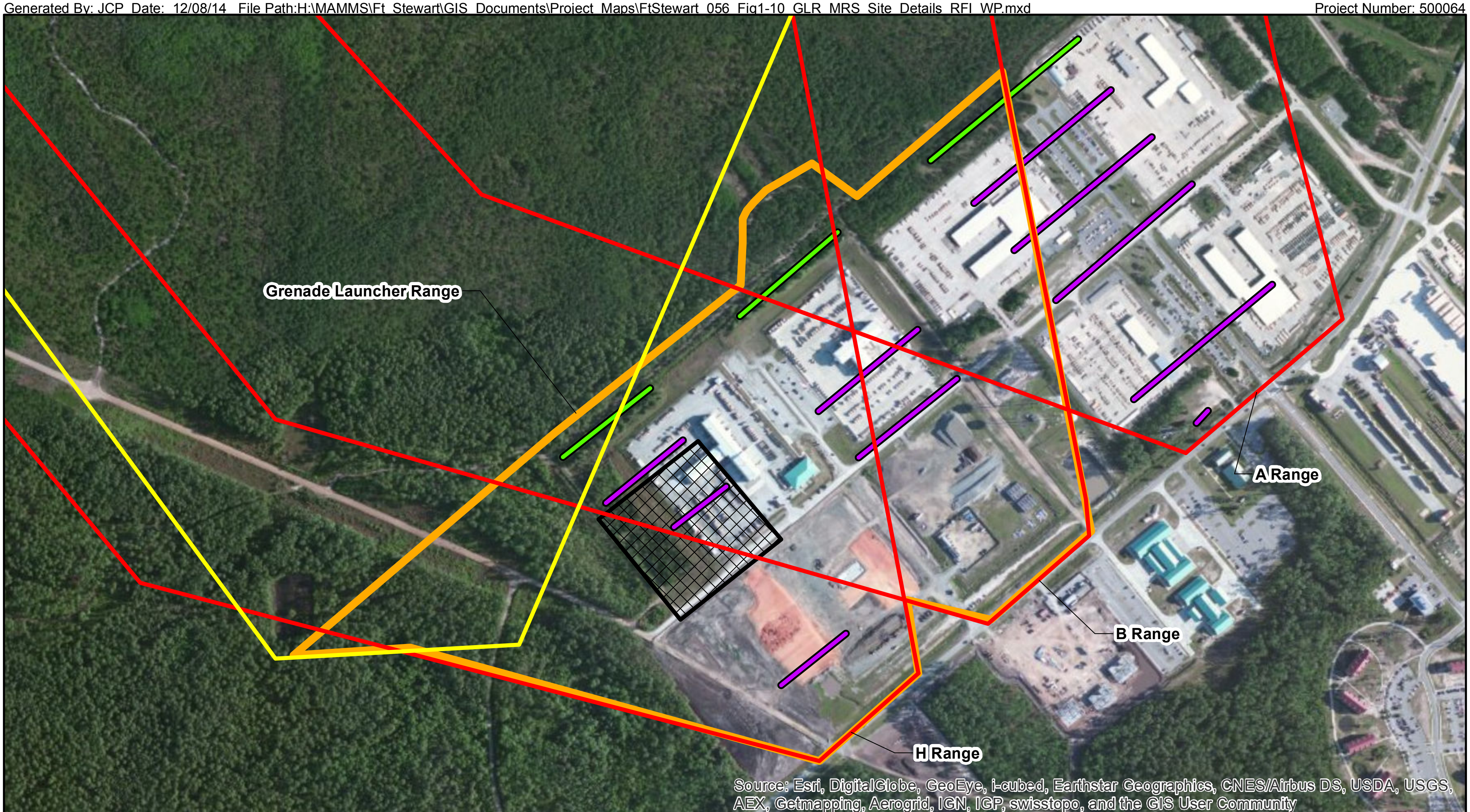

Firing Berm

Target Berm

Infiltration Course

Munitions Response Site Boundary

Historical Range Fans

Small Arms 1944

120-mm Anti-Aircraft

0 700 1,400 Feet

Projection : WGS_1984_UTM_Zone_17N

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BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

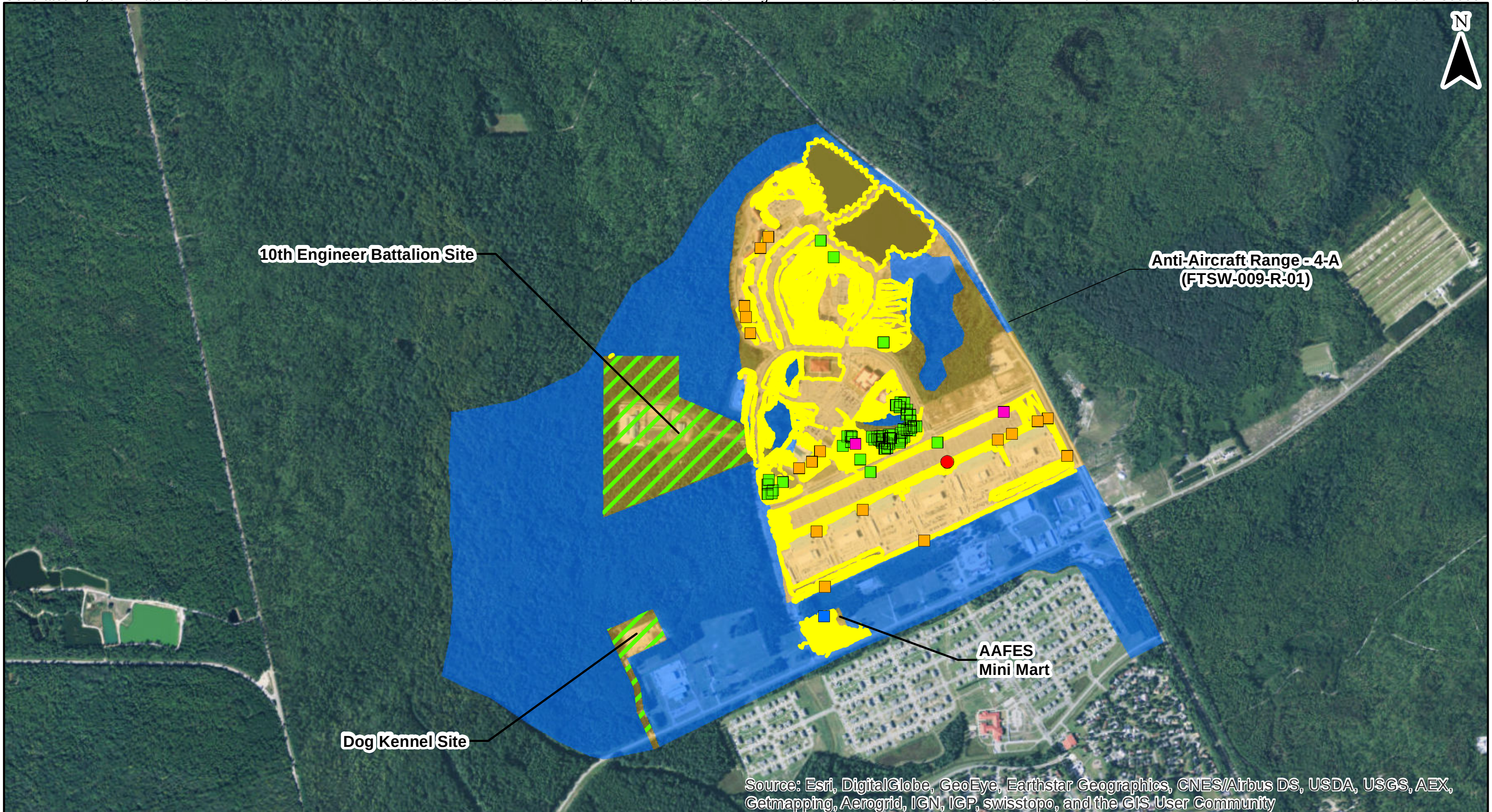
FIGURE NUMBER 1-10

GRENADE LAUNCHER RANGE MUNITIONS RESPONSE SITE DETAILS FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Generated By: JCP Date: 08/28/15 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_037_Fig1-11_AAR4AB_MRS_CENAB_Invest_RFI_WP.mxd

Project Number: 500064



- Partial PD Fuze
- 81mm Practice Mortar
- M2 Target Rocket
- Pit of Fuze Shipping Containers
- Munitions Debris
- GPS Position Covered While Walked, During Investigation
- Anti-Aircraft Range 4-B Munitions Response Site
- Anti-Aircraft Range 4-A Munitions Response Site
- TCRA Area

0 2,000 4,000 Feet

Note: Munitions debris items (including the 81mm practice mortar, M2 target rockets, and pit of fuze shippping containers) are approximate. Partial PD fuze location accuracy unknown.

Projection : WGS_1984_UTM_Zone_17N

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BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-11

ANTI-AIRCRAFT RANGE 4
CENAB INVESTIGATION LOCATIONS
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Generated By: JCP Date: 08/28/15 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_034_Fig1-12_AAR4AB_MRS_CS_Results_RFI_WP.mxd

Project Number: 500064

- Sample Location
- Previous EOD Response
- Transect Walked During Investigation
- Anti-Aircraft Range 4-B Munitions Response Site
- Anti-Aircraft Range 4-A Munitions Response Site
- Area Inaccessible Due to Construction

0 2,000 4,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-12

ANTI-AIRCRAFT RANGE 4 PHASE 2 CONFIRMATORY SAMPLING RESULTS FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

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Project Number: 500064

Sample Location

MDAS Location

Transect Walked During Investigation

Munitions Response Site Boundary

0 1,500 3,000 Feet

Projection : WGS_1984_UTM_Zone_17N

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BALTIMORE DISTRICT

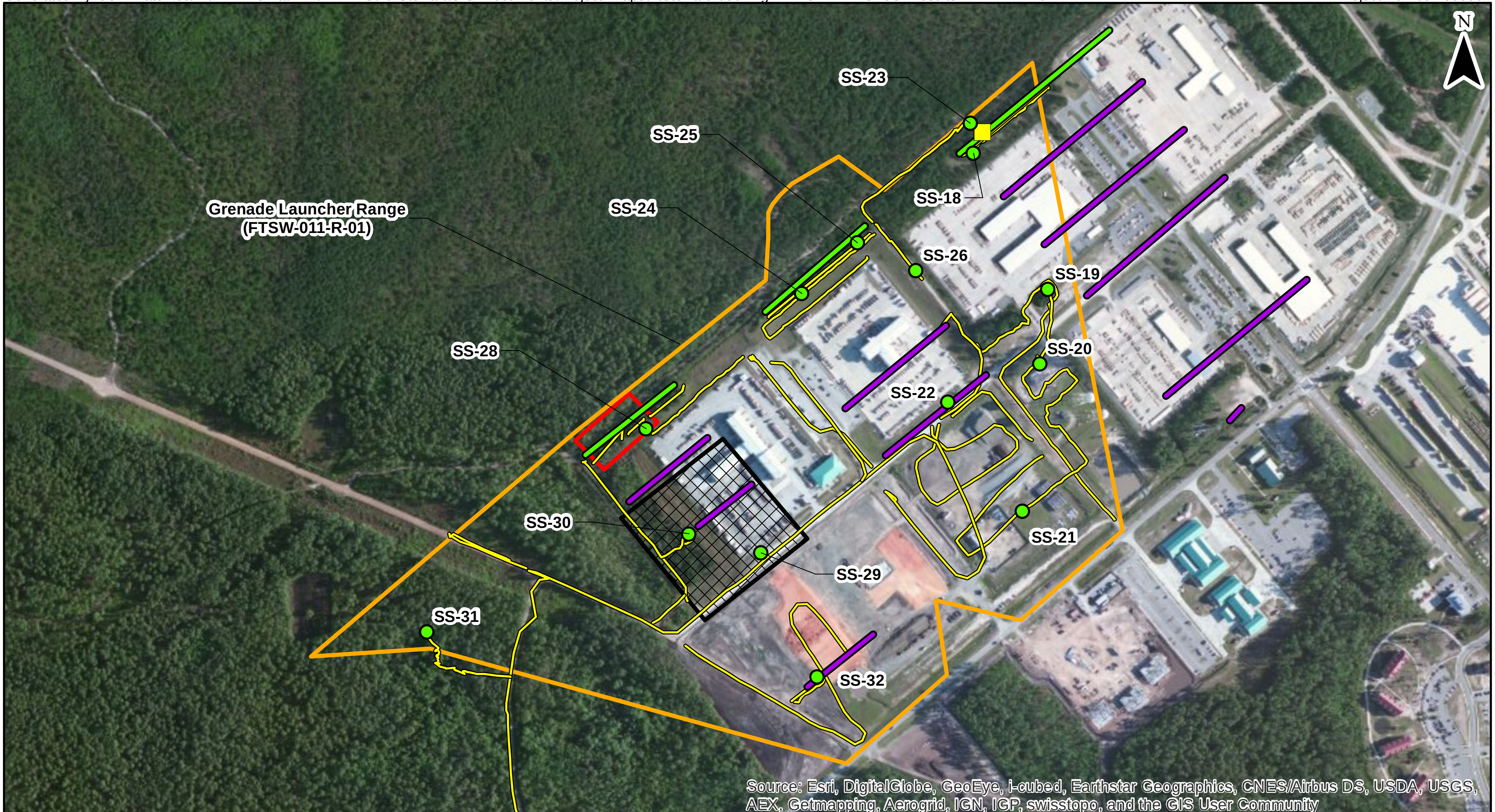
MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-13

ANTI-TANK RANGE 90-MM-2
PHASE 2 CONFIRMATORY SAMPLING RESULTS
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Generated By: JCP Date: 09/11/14 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_036_Fig1-14_GLR_MRS_CS_Results_RFI_WP.mxd Project Number: 500064



Sample Location
Expended 25mm Cartridge
Firing Berm
Target Berm
Transect Walked During Investigation
MDAS Area
Munitions Response Site Boundary
Infiltration Course

0 700 1,400 Feet

Projection : WGS_1984_UTM_Zone_17N

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BALTIMORE DISTRICT

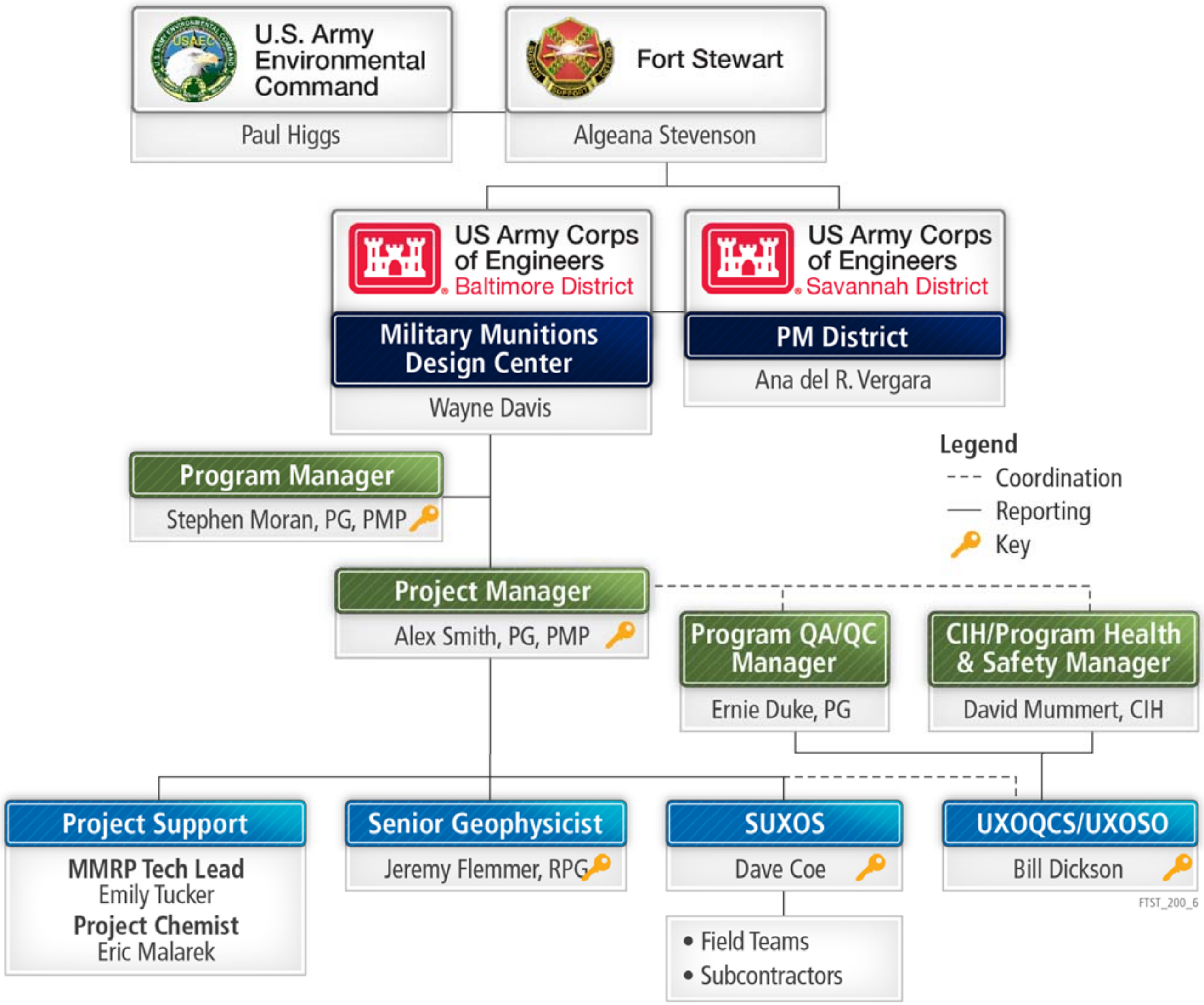
MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-14

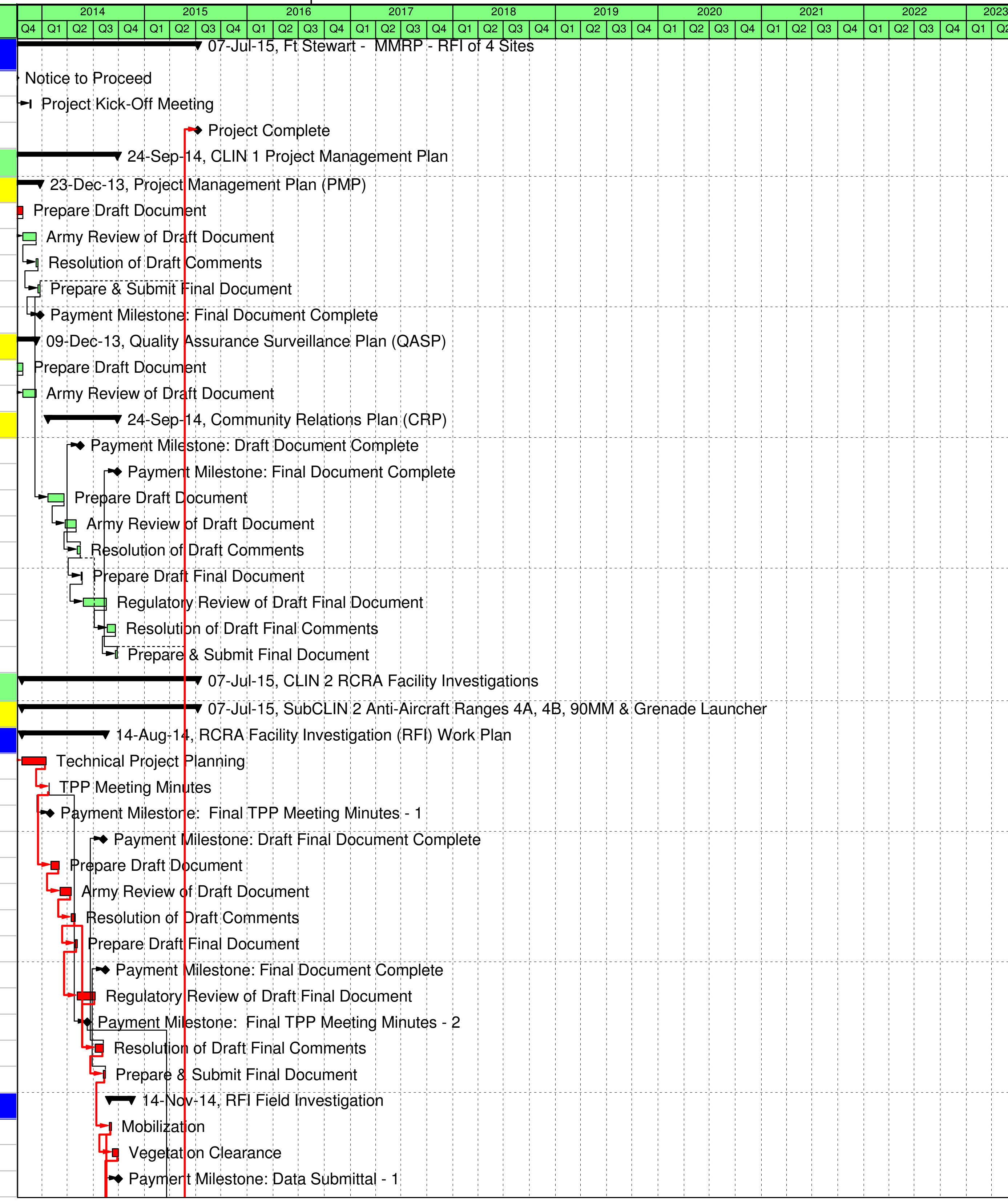
GRENADE LAUNCHER RANGE PHASE 2 CONFIRMATORY SAMPLING RESULTS FORT STEWART, GEORGIA

CB&I Federal Services
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Figure 2-1
Project Organization Chart

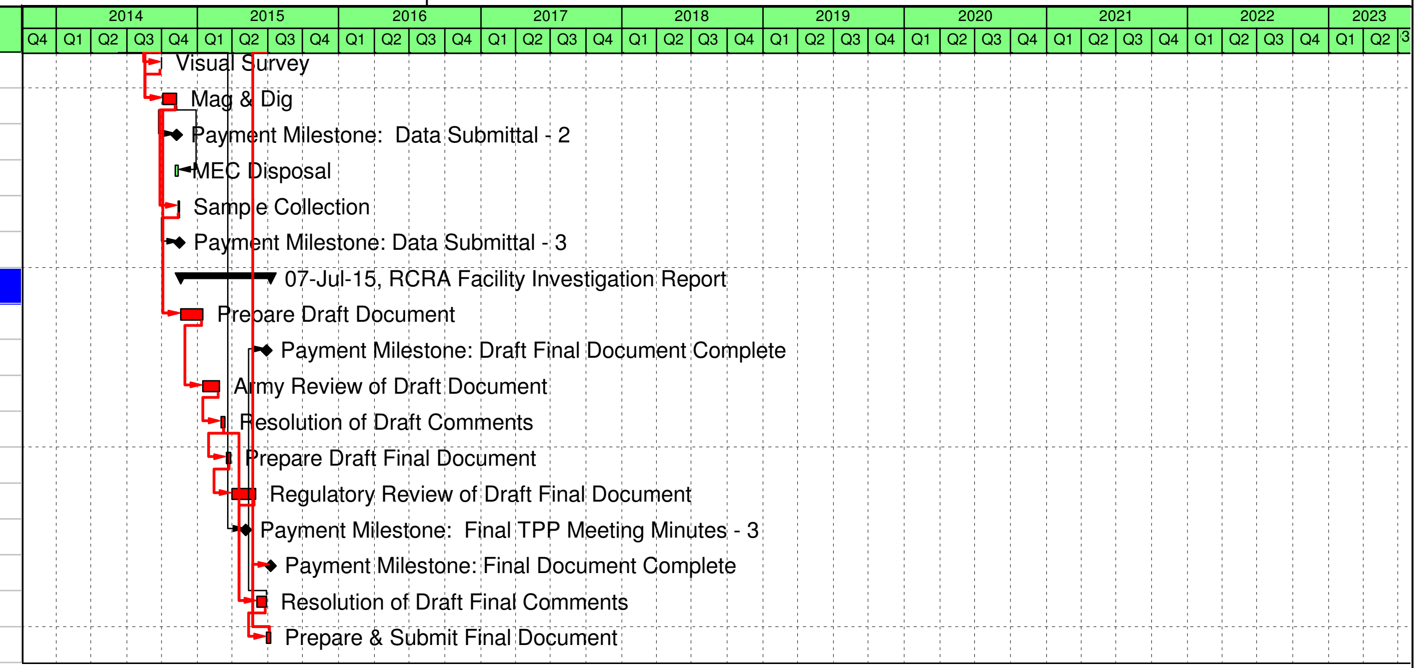


Activity ID	Activity Name	Original Duration	Start	Finish
Ft Stewart - MMRP - RFI of 4 Sites		445	26-Sep-13	07-Jul-15
A1000	Notice to Proceed	0	26-Sep-13*	
A1010	Project Kick-Off Meeting	1	21-Nov-13	21-Nov-13
A1020	Project Complete	0		07-Jul-15
CLIN 1 Project Management Plan		250	26-Sep-13	24-Sep-14
Project Management Plan (PMP)		60	26-Sep-13	23-Dec-13
0100110	Prepare Draft Document	20	26-Sep-13	24-Oct-13
0100115	Army Review of Draft Document	30	25-Oct-13	09-Dec-13
0100120	Resolution of Draft Comments	5	10-Dec-13	16-Dec-13
0100125	Prepare & Submit Final Document	5	17-Dec-13	23-Dec-13
0100140MP	Payment Milestone: Final Document Complete	0		23-Dec-13
Quality Assurance Surveillance Plan (QASP)		50	26-Sep-13	09-Dec-13
0100140	Prepare Draft Document	20	26-Sep-13	24-Oct-13
0100145	Army Review of Draft Document	30	25-Oct-13	09-Dec-13
Community Relations Plan (CRP)		170	24-Jan-14	24-Sep-14
0100125MP	Payment Milestone: Draft Document Complete	0		16-May-14
0100130MP	Payment Milestone: Final Document Complete	0		24-Sep-14
010310	Prepare Draft Document	40	24-Jan-14	21-Mar-14
010320	Army Review of Draft Document	30	24-Mar-14	02-May-14
010330	Resolution of Draft Comments	10	05-May-14	16-May-14
010350	Prepare Draft Final Document	5	19-May-14	23-May-14
010360	Regulatory Review of Draft Final Document	60	27-May-14	19-Aug-14
010370	Resolution of Draft Final Comments	20	20-Aug-14	17-Sep-14
010390	Prepare & Submit Final Document	5	18-Sep-14	24-Sep-14
CLIN 2 RCRA Facility Investigations		429	21-Oct-13	07-Jul-15
SubCLIN 2 Anti-Aircraft Ranges 4A, 4B, 90MM & Grenade Launcher		429	21-Oct-13	07-Jul-15
RCRA Facility Investigation (RFI) Work Plan		206	21-Oct-13	14-Aug-14
020100	Technical Project Planning	60	21-Oct-13	16-Jan-14
020105	TPP Meeting Minutes	1	27-Jan-14	27-Jan-14
020105MP	Payment Milestone: Final TPP Meeting Minutes - 1	0		29-Jan-14
020110MP	Payment Milestone: Draft Final Document Complete	0		07-Aug-14
020115	Prepare Draft Document	20	04-Feb-14	04-Mar-14
020120	Army Review of Draft Document	30	05-Mar-14	15-Apr-14
020125	Resolution of Draft Comments	10	16-Apr-14	29-Apr-14
020130	Prepare Draft Final Document	5	30-Apr-14	06-May-14
020130MP	Payment Milestone: Final Document Complete	0		14-Aug-14
020135	Regulatory Review of Draft Final Document	45	07-May-14	10-Jul-14
020135MP	Payment Milestone: Final TPP Meeting Minutes - 2	0		11-Jun-14
020140	Resolution of Draft Final Comments	20	11-Jul-14	07-Aug-14
020145	Prepare & Submit Final Document	5	08-Aug-14	14-Aug-14
RFI Field Investigation		53	29-Aug-14	14-Nov-14
020210	Mobilization	5	29-Aug-14*	05-Sep-14
020220	Vegetation Clearance	16	08-Sep-14	29-Sep-14
020220MP	Payment Milestone: Data Submittal - 1	0		29-Sep-14



Remaining Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | Summary

Activity ID	Activity Name	Original Duration	Start	Finish
020230	Visual Survey	2	30-Sep-14	01-Oct-14
020240	Mag & Dig	26	02-Oct-14	07-Nov-14
020240MP	Payment Milestone: Data Submittal - 2	0		07-Nov-14
020250	MEC Disposal	4	05-Nov-14	10-Nov-14
020260	Sample Collection	4	10-Nov-14	14-Nov-14
020270MP	Payment Milestone: Data Submittal - 3	0		14-Nov-14
RCRA Facility Investigation Report		160	17-Nov-14	07-Jul-15
020310	Prepare Draft Document	40	17-Nov-14	14-Jan-15
020310MP	Payment Milestone: Draft Final Document Complete	0		29-Jun-15
020315	Army Review of Draft Document	30	15-Jan-15	27-Feb-15
020320	Resolution of Draft Comments	10	02-Mar-15	13-Mar-15
020325	Prepare Draft Final Document	10	16-Mar-15	27-Mar-15
020330	Regulatory Review of Draft Final Document	45	30-Mar-15	01-Jun-15
020330MP	Payment Milestone: Final TPP Meeting Minutes - 3	0		05-May-15
020331MP	Payment Milestone: Final Document Complete	0		07-Jul-15
020335	Resolution of Draft Final Comments	20	02-Jun-15	29-Jun-15
020340	Prepare & Submit Final Document	5	30-Jun-15	07-Jul-15



Remaining Level of Effort | Remaining Work | Milestone
Actual Work | Critical Remaining Work | Summary

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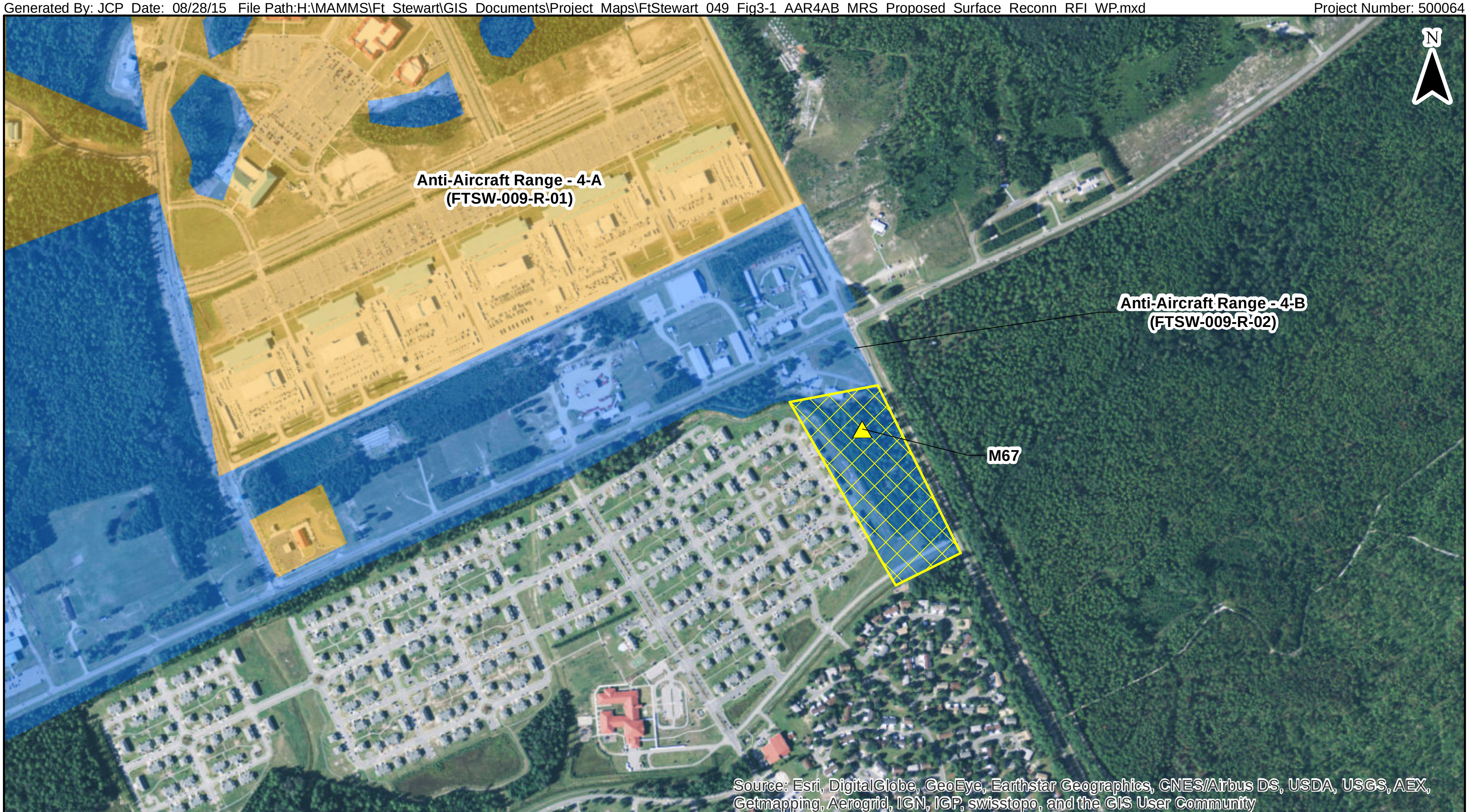

Previous EOD Response

Proposed Surface Clearance Area

Anti-Aircraft Range 4-B Munitions Response Site

Anti-Aircraft Range 4-A Munitions Response Site

0 1,000 2,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
3-1

ANTI-AIRCRAFT RANGE 4-B PROPOSED SURFACE RECONNAISSANCE FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

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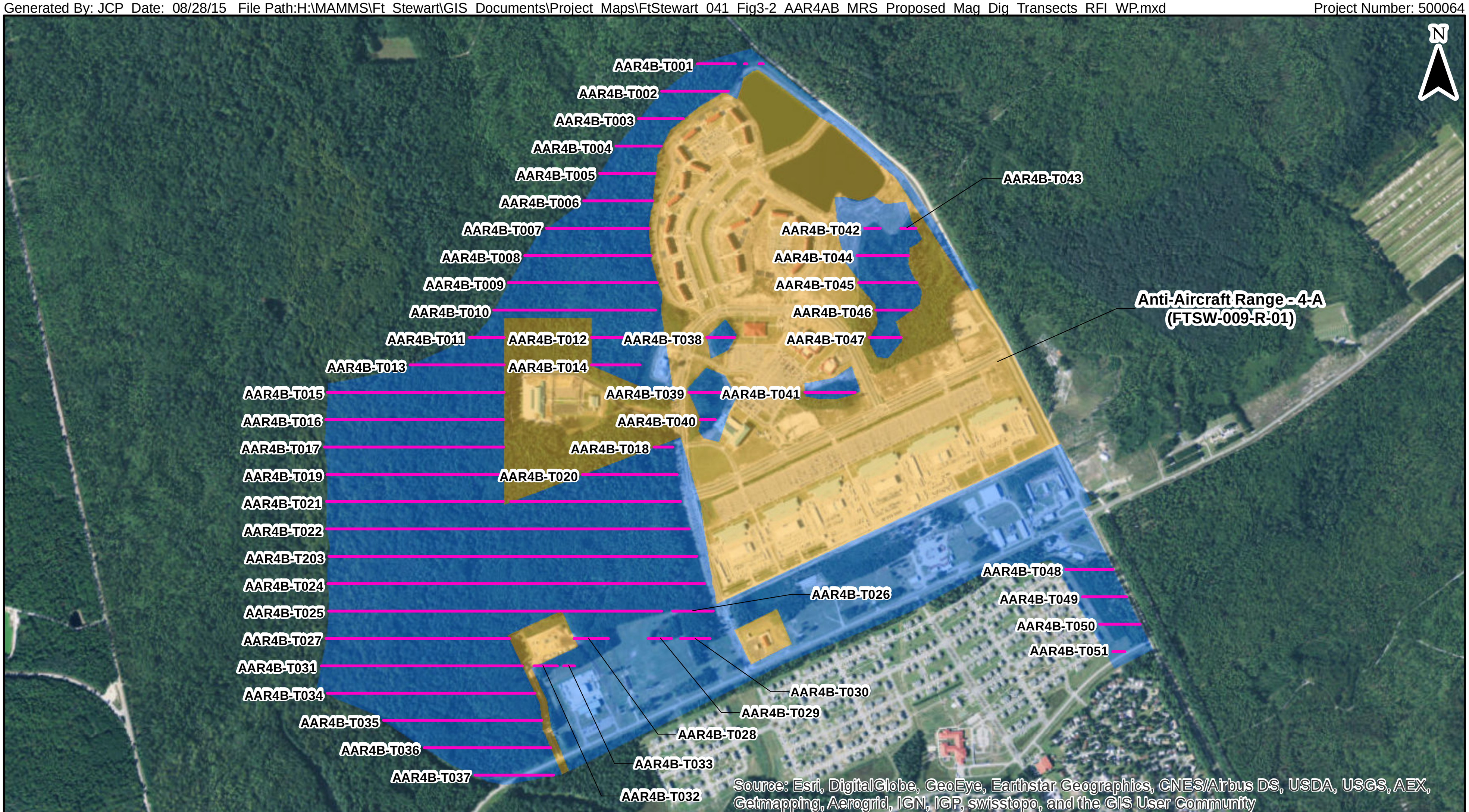

Proposed Mag & Dig Transect (Transect Width of 4 Feet)

Anti-Aircraft Range 4-B Munitions Response Site

Anti-Aircraft Range 4-A Munitions Response Site

0 1,700 3,400 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
3-2

ANTI-AIRCRAFT RANGE 4
PROPOSED MAG & DIG INVESTIGATION
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

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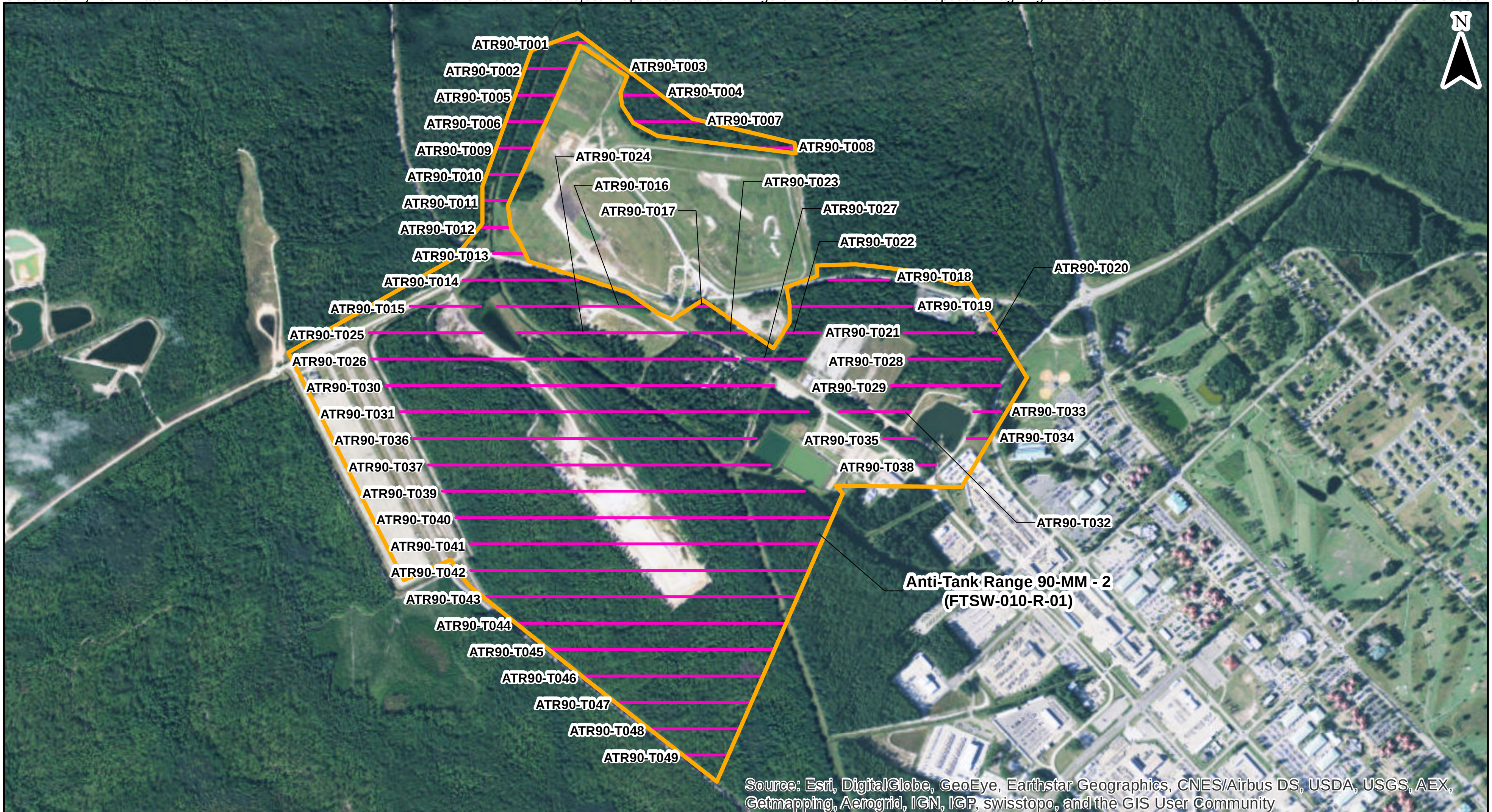

Proposed Mag & Dig Transect (Transect Width of 4 Feet)

Munitions Response Site Boundary

0 1,500 3,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-3

ANTI-TANK RANGE 90-MM-2 PROPOSED MAG & DIG INVESTIGATION FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

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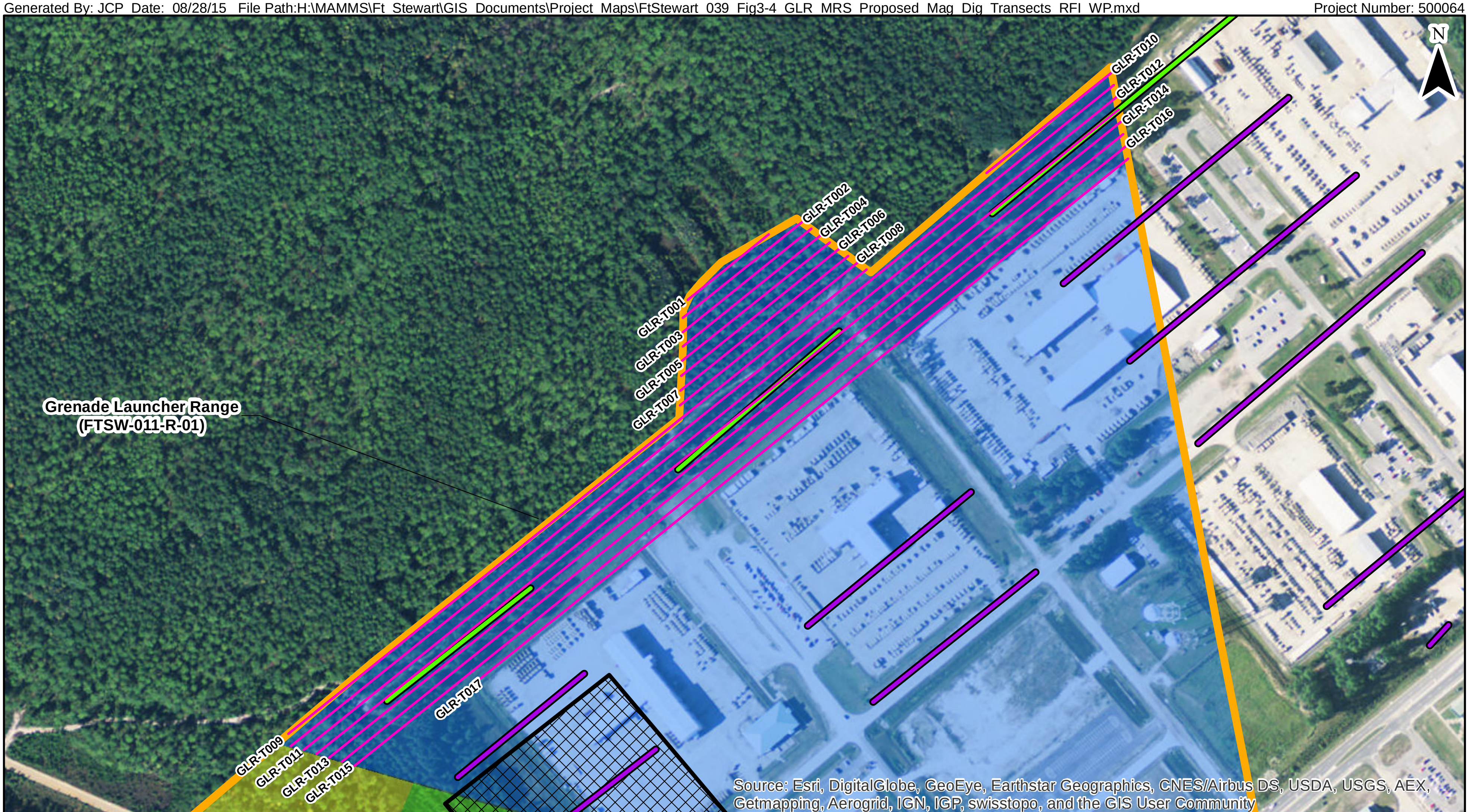
Project Number: 500064



Proposed Mag & Dig Transect (Transect Width of 4 Feet)

Firing Berm

Target Berm

Infiltration Course

Munitions Response Site Boundary

Suspected Munitions Areas

Grenade Launcher and Small Arms

120-mm Anti-Aircraft and Small Arms

Small Arms

0 425 850 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS

BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

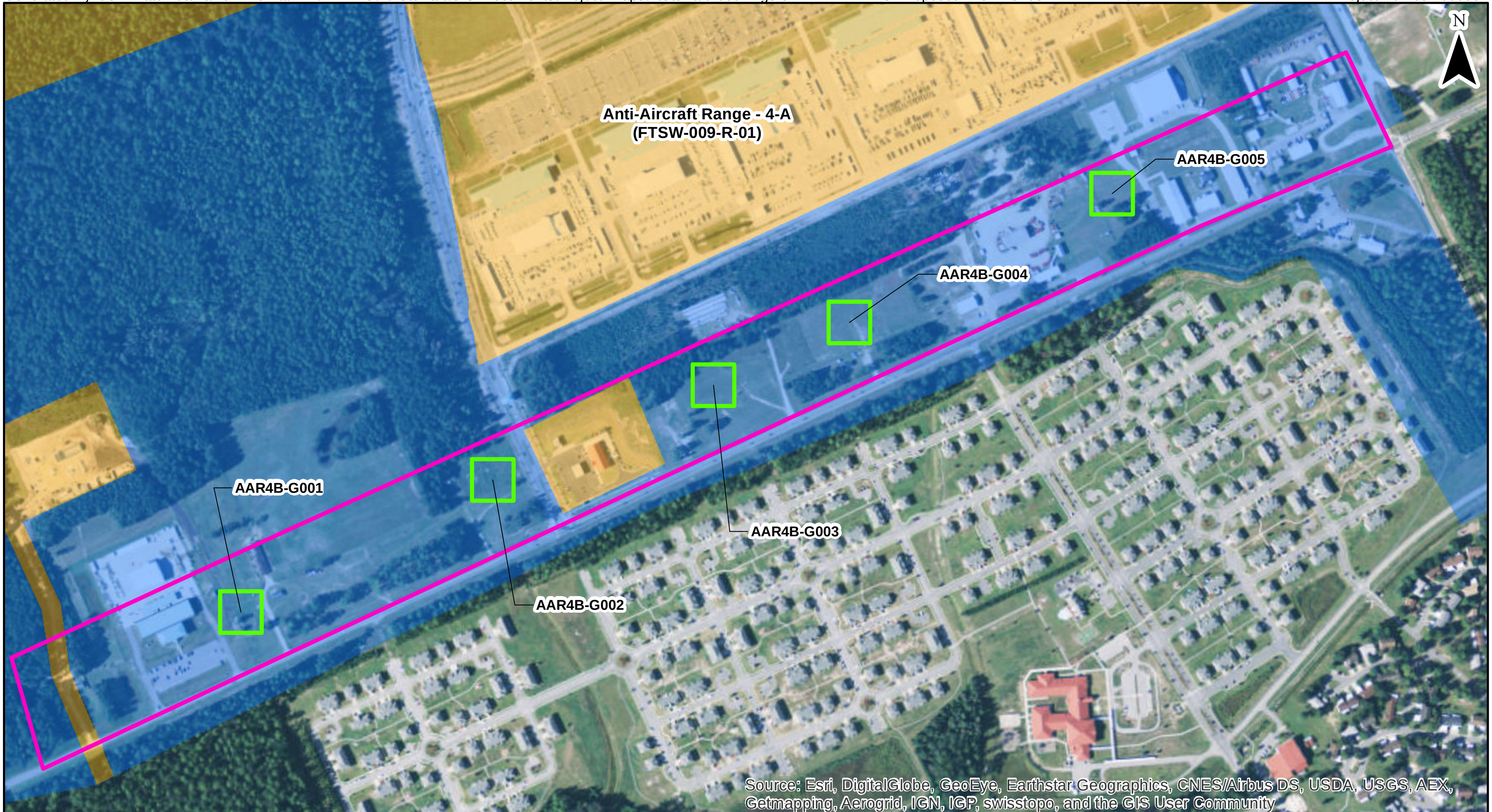
FIGURE NUMBER

3-4

GRENADE LAUNCHER RANGE
PROPOSED MAG & DIG INVESTIGATION
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Generated By: JCP Date: 08/28/15 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_050_Fig3-5_AAR4AB_MRS_Proposed_DGM_Grids_RFI_WP.mxd Project Number: 500064



Proposed DGM Grid (200 x 200 ft)

Approximate Historical Firing Points Boundary

Anti-Aircraft Range 4-A Munitions Response Site

Anti-Aircraft Range 4-B Munitions Response Site

0 700 1,400 Feet

Projection : WGS_1984_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-5

ANTI-AIRCRAFT RANGE 4
PROPOSED DGM INVESTIGATION
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

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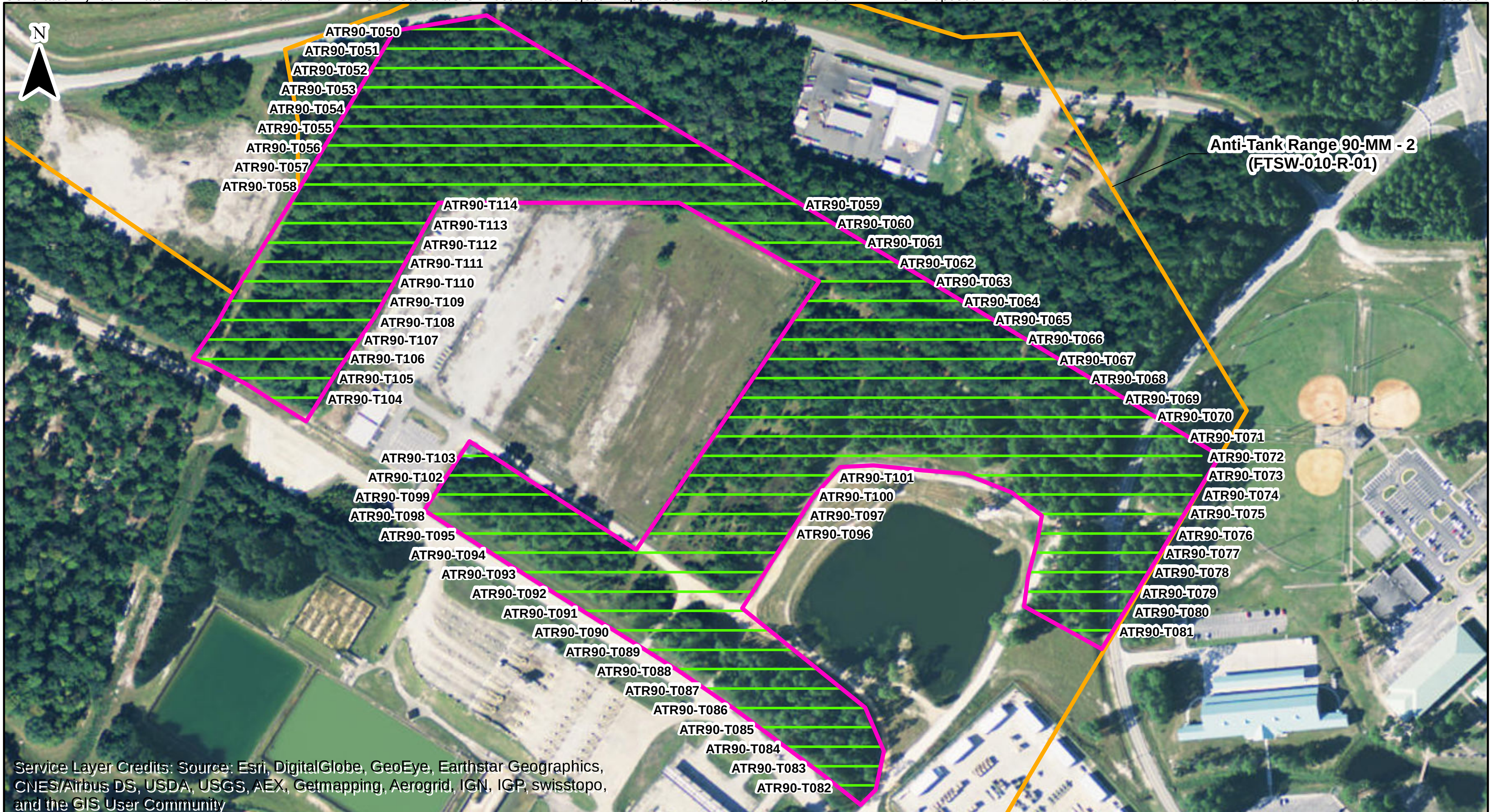

Proposed DGM Transect (Transect Width of 4 Feet)

Munitions Response Site Boundary

Approximate Historical Firing Points Boundary

0 375 750 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY
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BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
3-6

ANTI-TANK RANGE 90-MM-2
PROPOSED DGM INVESTIGATION
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

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Proposed DGM Transect (Transect Width of 4 Feet)

Munitions Response Site Boundary

Approximate Historical Firing Points Boundary

Historic Range Fan

120-mm Anti-Aircraft

0 150 300 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

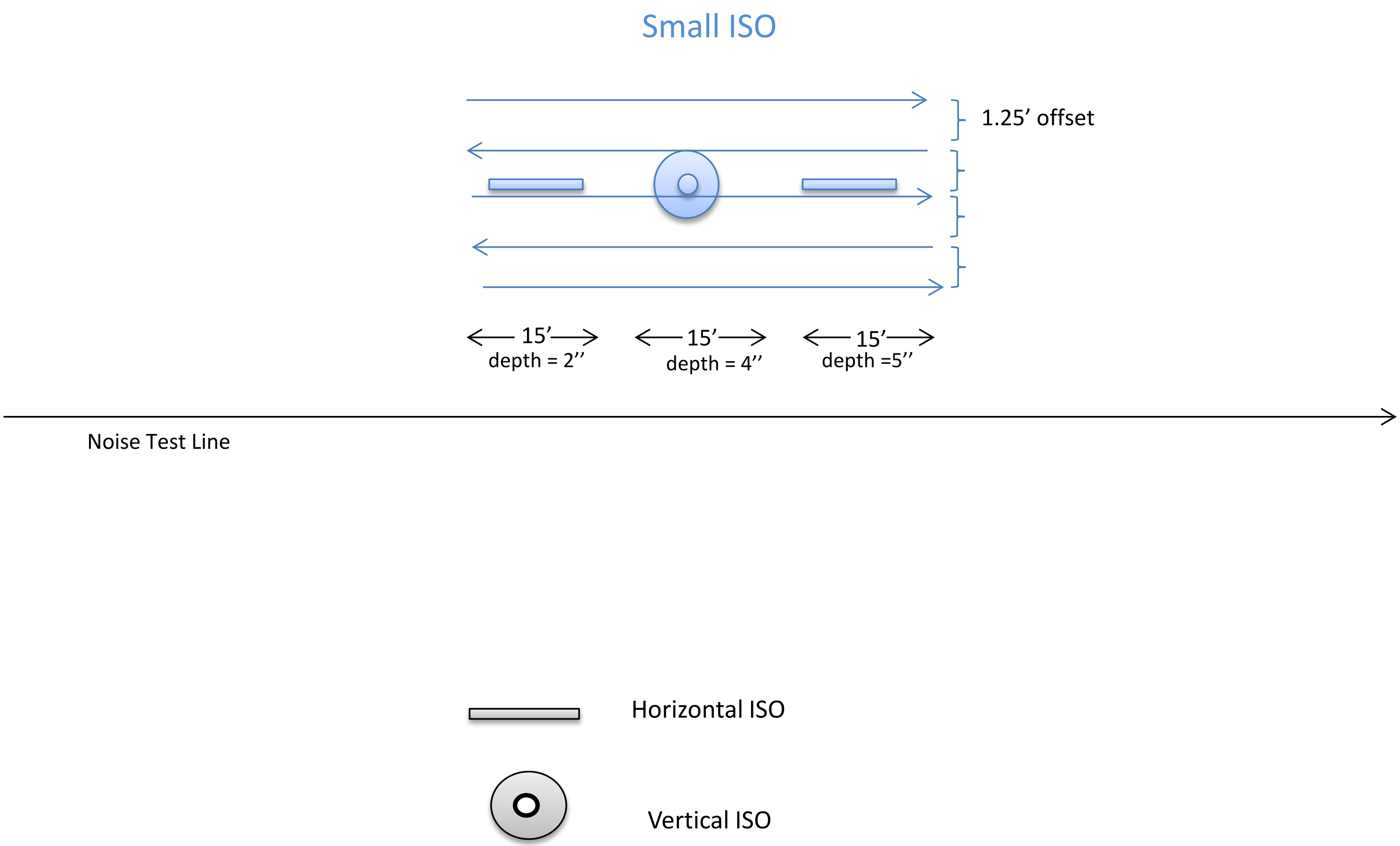
MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
3-7

GRENADE LAUNCHER RANGE
PROPOSED DGM INVESTIGATION
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

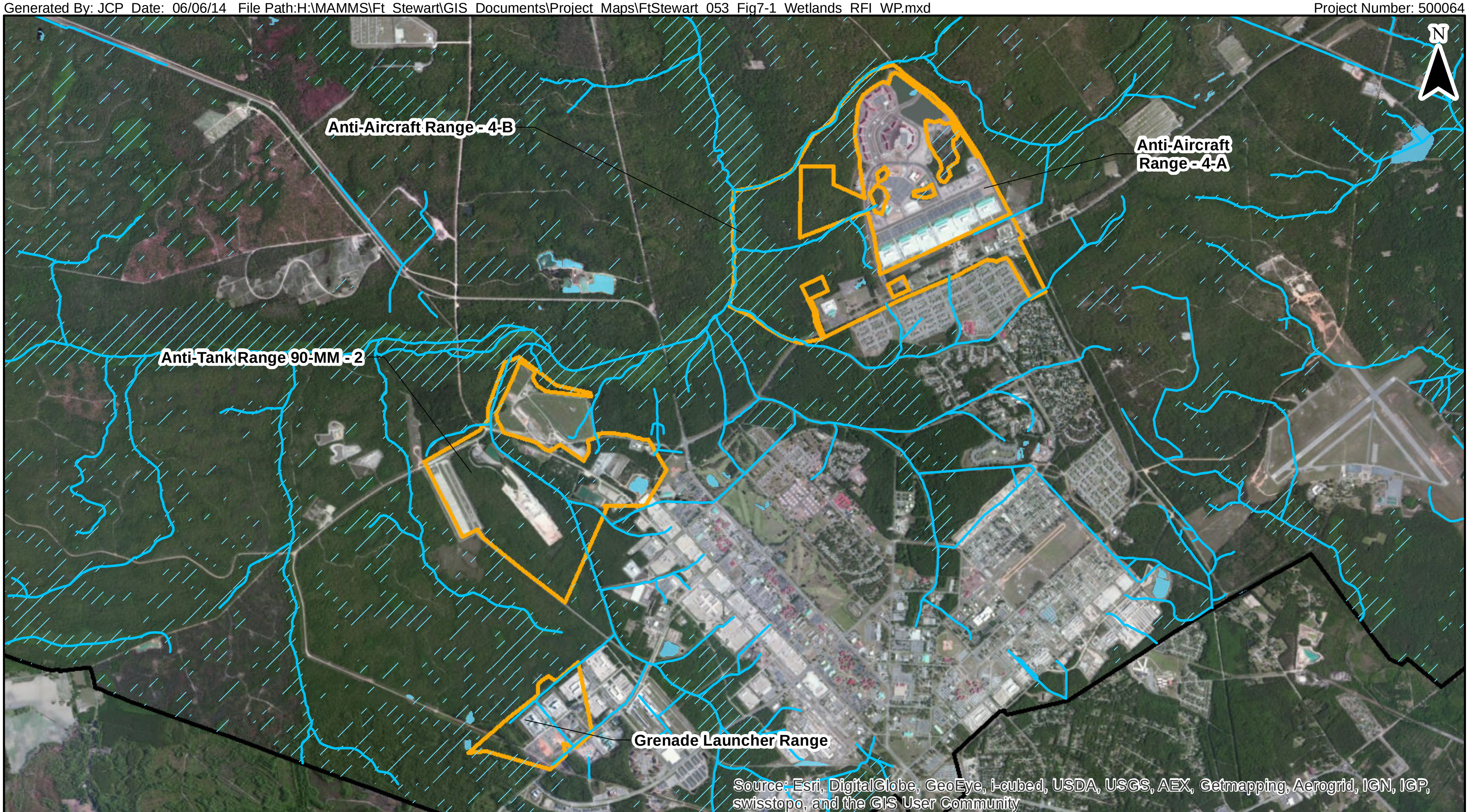
Figure 3-8 IVS Design



ISO industry standard object
Depth= depth to center of ISO

Generated By: JCP Date: 06/06/14 File Path:H:\MAMMS\Ft_Stewart\GIS_Documents\Project_Maps\FtStewart_053_Fig7-1_Wetlands_RFI_WP.mxd

Project Number: 500064



Water Feature

Munitions Response Site Boundary

Fort Stewart Installation Boundary

Water Body

Wetland

Notes:
1) Water features and bodies source: National Hydrography Dataset, U.S. Geological Survey (USGS).
1) Wetlands source: National Wetlands Inventory, U.S. Fish & Wildlife Service (USFWS).

0 4,500 9,000 Feet

Projection : WGS_1984_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
BALTIMORE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
7-1

WETLANDS
FORT STEWART, GEORGIA

CB&I Federal Services LLC
4696 Millennium Drive, Suite 320
Belcamp, Maryland 21017

Appendix C
Local Points of Contact

Key Individuals for Fort Stewart			
Name	**Title**	**Address**	**Contact Info**
FORT STEWART			
Algeana Stevenson	Remediation Section Leader	DPW Prevention and Compliance Branch 1550 Veterans Parkway, Bldg. # 1137 Fort Stewart, GA 31314-4927	(912) 315-5144 algeana.l.stevenson.civ@mail.mil
USACE			
Kathryn Brown	USACE Contracting Officer (KO)	U.S Army Corps of Engineers Attn: CENAB-CT 10 South Howard Street Baltimore, MD 21201-1715	(410) 962-2585 Kathryn.E.Brown@usace.army.mil
Travis McCoun	USACE Contracting Officer's Representative (COR)	U.S. Army Corps of Engineers Attn: CENAB-EN-HM 10 South Howard Street, RM 10040-X Baltimore, MD 21201-1715	(410) 962-6728 (443) 844-8192 cell Travis.McCoun@usace.army.mil
Ana del R. Vergara	USACE Senior Project Manager	Environmental and I2S Branch U.S Army Corps of Engineers, Savannah District 100 W. Oglethorpe Avenue Savannah, GA 31401	(912) 652-5835 Ana.delR.Vergara@usace.army.mil
USAEC			
Paul Higgs	Environmental Restoration Manager (ERM)	U.S. Army Environmental Command 2450 Connell Road Fort Sam Houston, Texas 78234	(210) 466-1727 paul.a.higgs.civ@mail.mil
CB&I			
Steve Moran	MAMMS Program Manager	CB&I Federal Services LLC 312 Directors Drive Knoxville, TN 37923	(865) 694-7361 (865) 607-9148 cell steve.g.moran@cbifederalservices.com
Alex Smith	Project Manager	CB&I Federal Services LLC 4696 Millennium Drive, Suite 320 Belcamp, MD 21017	(410) 273-7313 (240) 586-1341 cell (225) 952-3016 eFax alexander.smith@cbifederalservices.com
Gail Carter	Contract Administrator	CB&I Federal Services LLC 1725 Duke Street, Suite 400 Alexandria, VA 22314	(202) 261-1900 gail.carter@cbifederalservices.com

Appendix D
Contractor Forms

FINAL INSPECTION FORM

DATE: Page ___of ___		
CONTRACT NO.:	TITLE AND LOCATION:	DELIVERY ORDER NO.:
CONTRACTOR: CB&I Federal Services LLC	NAME OF SITE SUPERINTENDENT:	
INSPECTED WORK:		COMPLETION DATE:

PERFORMANCE SPECIFICATION BY CONTRACT DELIVERY ORDER REFERENCE	STATUS OF INSPECTION

On behalf of CB&I Federal Services LLC, I certify that the work inspected is complete and meets the performance specifications cited above and that all material and equipment used and work performed was completed in accordance with approved plans and work instructions and meets contract delivery order requirements.

QC Officer ______________________ Date ______________

INITIAL INSPECTION

Contract No.:	Date:
Definable Feature of Work:	Specification References:
CQC System Manager:	Project Manager:
Notifications:	

I. Personnel Present

Name	Position	Affiliation

II. Preparatory Inspection

Verify full compliance with procedures identified at preparatory inspection. Coordinate plans, specifications, and submittals.

Comments:

INITIAL INSPECTION

III. Preliminary Work

Is all preliminary work complete and correct? If not, what action is taken?

IV. Level of Workmanship

Where is work located?
Is a sample panel required?
Will the initial work be considered as a sample?

V. Discrepancies

Are there any discrepancies between planned and actual conditions and/or practices? If so, explain the discrepancies and actions taken.

VI. Safety

Review job conditions against governing safety documents (e.g. HASP, USACE EM 385-1-1) and job hazard analysis.

INSPECTION SCHEDULE AND TRACKING FORM

Project:	**Project Manager:**	**CQC System Manager:**

Reference No.	Definable Feature of Work	Preparatory		Initial		Follow-up		Completion		
		Date Planned	Actual Date	Date Planned	Actual Date	Planned Begin/End	Actual Dates	Planned Begin/End	Actual Dates	Status

PREPARATORY INSPECTION

Contract No.:	Date:
Definable Feature of Work:	Specification Reference: NA
CQC System Manager:	Project Manager:
Notifications:	

I. Personnel Present

Name	Position	Affiliation

PREPARATORY INSPECTION

II. Submittals

Have all submittals been approved? If not, what items have not been submitted? The site Work Plan rewrite will be submitted for review and approval.
Are all materials on hand? If not, what items are missing?
Do approved submittals correspond to delivered materials? All delivered materials have been inspected to be in accordance with the Procurement Requisition. No discrepancies have been noted. If not, what discrepancies are found?

III. Material Storage

Are materials stored properly? If not, what action is taken?

IV. Specifications

Required Action	Comments
Review each paragraph of specifications.	
Discuss procedure for accomplishing work.	

PREPARATORY INSPECTION

Clarify any differences.	

V. Preliminary Work Permits

Ensure preliminary work is correct and permits are on file. If not, what action is taken?

VI. Testing

Is test plan complete and accurate? If not, what action is taken?
Has each testing organization been approved? If not, what action is taken?

VII. Safety

Review applicable portion of governing safety document (e.g., USACE EM 385-1-1).
Activity Hazard Analysis approved?

VIII. Client Comments

CQC System Manager Signature/Date: ____

NCR TRACKING LOG

NCR Number	Date of Issue	Subject	Responsible Organization	Impact on Other Activities	Date of Disposition Approval	Date of Corrective Action Verification	Remarks

NONCONFORMANCE REPORT

NONCONFORMANCE REPORT	NCR Report No.:
	Date:
Project:	Delivery/Task Order No.:
Feature of Work:	Responsible Organization: (CB&I, Subcontractor, Supplier, etc.)

References: (Specification, Drawing, Procedure, incl. rev.)

Description of Nonconforming Condition:

Organization Code:____________ Inspection Code:____________ Nonconformance Cause Code:______________

Disposition Category:

☐ Rework ☐ Repair ☐ Use-As-Is ☐ Return to Vendor ☐ Scrap/Reject

Disposition & Corrective Action:

NCR Initiated By:_____________________________ Date:_________________
QC Representative

Disposition and Corrective Action Provided By:___________________________________ Date:__________________
CB&I Engineer / Responsible Organization

Disposition and Corrective Action Approved By:_______________________ Date:__________________
Project Manager

Disposition and Corrective Action Completed By:______________________ Date:__________________
Responsible Organization

Disposition and Corrective Action Verified By:_________________________ Date:__________________
QC Representative

Nonconformance Report Form Instructions:

Initiator: Complete the upper portion of the report by providing the following information:

NCR Report Number - Unique NCR number per procedure (e.g. 97-19656-01).
Date - Date that the Nonconforming Condition was detected.
Project - Name of the Project.
Delivery / Task Order Number - Delivery / Task Order number applicable to project work.
Feature of Work - Actual feature of work i.e. Soil/concrete placement, pump installation, etc.
Responsible Organization - Organization responsible for the nonconformance.
References - Source requirements in which the condition is nonconforming to.
Description Of Non-conforming Condition - Complete description of the condition supplemented by photographs, sketches, reports and other documents.
Organization Code - See below
Inspection Code - See Below
Cause Code - See Below

Provide signature and issue date at the bottom of the form

Organization Codes:

001 Engineering/Design	006 Field Sampling/Analytical
002 Vendor/Supplier	007 Purchasing
003 Operations	008 Project Management
004 Subcontractor	009 Health & Safety
005 Quality Control	010 Program Management

Inspection Codes:

100 Receipt Inspection
200 In-process Inspection (incl. Preparatory, Initial or Follow up)
300 Completion / Final Inspection

Nonconformance Codes:

101 Indeterminate	107 Damage
102 Inadequate Documentation	108 Improper Handling, Storage, or Shipping
103 Inadequate Plan/Procedure	109 Poor Workmanship
104 Failure to Follow Plan/Procedure	110 Incomplete Work Performance
105 Fails to meet Specification	111 Test Failure
106 Fails to meet Drawing Dimensions	112 Poor Maintenance

Disposition Category: To be checked by the individual responsible for providing both disposition and corrective action. Check the appropriate box.

Corrective Action: Provide a complete corrective action that will ensure that the condition will be made to meet the disposition requirements. Corrective action shall include identification of the cause, steps to be taken to correct the condition, and steps to be taken to preclude recurrence, where possible. Use attachments where necessary.

Responsible Organization: Complete the corrective action as describe in the corrective action portion of the form and its attachments. Sign and date the Disposition and Corrective Action Completed By line at the bottom portion of the form.

Disposition & Corrective Action Verification: Disposition and Corrective Action will be verified by QC Representative. Once verification is considered complete and acceptable the QC Representative will sign and date the Disposition and Corrective Action Verified By line at the bottom of the form indicating closure of the report.

DAILY CONSTRUCTION QUALITY CONTROL REPORT

Report No. ______________

Contract No. ____________________ CTO No. ________ Date: ______________

Number of Manhours worked onsite through today

WEATHER: ☐ Clear ☐ P. Cloudy ☐ Cloudy Wind ______________________________

Temperature: High _______ Low _______

Precipitation: Today None Previous Period (e.g., weekend) ____________________

Site Conditions: Dry

Lost Time Due to Inclement Weather: ________________ %

PRIME CONTRACTOR/SUBCONTRACTORS AND AREAS OF RESPONSIBILITY/LABOR COUNT:
(Include number, trade, hours, employer, location, and description of work)

a.

WORK PERFORMED (Include location and description of work performed including equipment used. Refer to work performed by prime and/or subcontractors as previously designated by letter above. Attach subcontractor daily activity reports when applicable):

1.

MATERIALS AND/OR EQUIPMENT DELIVERED: (Include a description of materials and/or equipment, quantity, date/hours used, date of safety check, and supplier).

RESULTS OF SURVEILLANCE: (Include satisfactory work completed or deficiencies with action to be taken)

a. Preparatory Inspection: (Attach minutes)

b. Initial Inspection: (Attach minutes) See attached Initial Inspection Form

c. Follow-Up Inspection: (List results of inspection compared to specification requirements.)

d. Final Inspection:

e. Completion Inspection: (USACE)

f. Safety Inspection:(Include safety violations and corrective actions taken.)

OFF-SITE SURVEILLANCE ACTIVITIES:(Include action taken)

QC TESTS PERFORMED AND RESULTS: (As required by plans and/or specifications.)

1.

VERBAL INSTRUCTIONS RECEIVED OR GIVEN: (List any instructions received from government personnel or given by IT on construction deficiencies identified, required retesting, etc., and the corresponding action to be taken.)

CHANGED CONDITIONS/DELAYS/CONFLICTS ENCOUNTERED: (List any conflicts with the delivery order [e.g., scope of work and/or drawings], delays to the project attributable to site, and weather conditions, etc)

SUBMITTALS REVIEWED: (Include submittal number, specification reference, and name of submitter.)

1.

DAILY CONSTRUCTION QUALITY CONTROL REPORT

MEETINGS: (List the meetings, e.g., Health and Safety, Site Operations, Cost/Schedule, etc.)

VISITORS: (See attached visitors log)

REMARKS: (Any additional information pertinent to the project not defined by the previous entries.)

Attachments:

CONTRACTOR'S VERIFICATION: The above report is complete and correct. All materials and equipment used and work performed during this reporting period are in compliance with the contract plans and specifications except as noted above:

Construction QC System Manager

CORRECTIVE ACTION REQUEST

CAR Number:______________________ Date Issued:_______________
Subject:____
Responsible Organization:___________________________ Location:___________________ Project Number:_______________

Reference Requirement(s):

Description of Condition:

Classification: Significant ? Yes_____ No_____ (If Yes, Corrective Actions 1, 2, 3, & 4 Below Apply)
Stop Work Warranted ? Yes_____ No____.

Corrective Action Required:

1. Remedial Action Required (always) Yes_X__ No____
2. Root Cause Determination Yes____ No____
3. Action to Prevent Recurrence Yes____ No____
4. Action Regarding Similar Work Yes____ No____

Response Due Date:_________________

Initiator:______________________________ Date:_______________

Proposed Corrective Action:

Proposed Completion Date:_________________

Responsible Individual:_____________________________________ Date:_______________

Evaluated By:____ Date:_______________

Completed Corrective Action Verification & Closure:

Verification Method:

Verifier:____ Date:_______________

CORRECTIVE ACTION REQUEST TRACKING & STATUS LOG

CAR No.	Date Issued	Subject	Response Due Date	Date Evaluated	Date Completed	Date Verified

CAP NUMBER:	
[ ] FYI	[ ] APPROVAL REQ'D

CORRECTIVE ACTION PLAN (CAP)

1. CAP number is lowest corresponding CAR number. Designate revisions with original CAP number followed by consecutive letter.
2. Attach clarifications and additional information as needed. List attached material in appropriate section of the CAP.

PART A: TO BE COMPLETED BY PROJECT MANAGER OR DESIGNEE.

CONTRACT:	PROJECT:	
PROJECT MANAGER:	QUALITY MANAGER: Kenneth Martinez	
CAR NO(S) & DATE(S) ISSUED:		
DEFICIENCY DESCRIPTION & LOCATION:		
RESULTS OF ROOT CAUSE ANALYSIS:		
PLANNED ACTIONS 1. 2. 3.	ASSIGNED RESPONSIBILITY	COMPLETION DUE DATE
PROJECT MANAGER SIGNATURE:	DATE:	

PART B: TO BE COMPLETED BY ISSUING AGENT OR DESIGNEE.

CAP REVIEWED BY:	DATE:
REVIEWER COMMENTS:	
CAP DISPOSITION: (CHECK ONLY ONE & EXPLAIN WHERE NEEDED) [ ] APPROVED WITHOUT STIPULATIONS [ ] APPROVED WITH STIPULATIONS: [ ] APPROVAL DELAYED, FURTHER PLANNING REQUIRED:	
AUTHORIZED BY (PRINTED NAME & TITLE): SIGNATURE:	DATE:

Demolition Operations Health and Safety Checklist

Equipment		
Item	**Quantity**	**Comments**
Air Horn, Emergency		
Bloodborne Pathogen Kit		
Burn Blanket		
Burn Kit		
Copper Sulfate (WP Operations)		
Fire Blanket		
Fire Extinguisher, 10 lb. ABC		
Stretcher		
Water, 5-gal. bottle (emergency shower)		
Water, drinking, 1-liter per person		
Other:		
PPE		
Item	**Quantity**	**Comments**
Safety Glasses		
Cotton Clothing		
Work Boots		
Leather Apron		WP Operations
Leather Gauntlets		WP Operations
Face Shield		WP Operations
Gloves, leather		
Goggles		
Rain Suit(s) (as required)		
Safety Vests		
Welders' Aprons (as required)		
Welders' Gloves (as required)		
Other:		

Location:	*Project Number:*
UXOSO Printed Name and Signature:	*Date:*

Disposal Operations Checklist

Function	Date/Time	Signature
Senior Unexploded Ordinance Supervisor		
Assign Disposal Team		
Brief Disposal Team: Review emergency procedures Discuss MEC/MDEH/MC to be disposed Describe disposal procedures		
Inspect Range/Exclusion zone after operation		
Disposal Supervisor		
Verify Bravo Flag is hoisted (if used)		
Verify affected roads are closed and barricaded/manned		
Verify exclusion zone (EZ) boundaries are in place		
Complete health/safety and demolition equipment checklists		
Ensure Command Center has made required notifications: Client (if required) Responsible activity (base operations, etc.) Base Security/Police Department Base Fire Department Medical Facility		
Disposal Supervisor tailgate safety brief: Review disposal procedures Designate emergency vehicles/drivers Discuss emergency evacuation route Review emergency response procedures Review safety precautions		
Verify communications (radios, cell phones) are operable		
Verify daily equipment inspection has been completed		
Verify caps/detonators are separated from explosives		
Complete required equipment testing has been completed		
Reconfirm EZ is not occupied by non-essential personnel		
Notify Command Center disposal operations are commencing		
Commence disposal operations		
Inspect shot after designated wait time		
Collect all metal fragments for later disposal		
QC Check performed		
QA check (if required)		
Command Center notify upon completion: Client Responsible activity (base operations, etc.) Base Security/Police Department Base Fire Department Medical Facility		
Complete MEC/MDEH/MC Accountability Log		
Demobilize		
Record data in Explosives Disposal Log		
Project Location:		Project Number:
Demolition Supervisor Signature:		Date:

Demolition Equipment Checklist

Equipment		
Item	**Quantity**	**Comments**
Explosive Vehicle(s)		
Personnel Vehicle(s)		
Camcorder/Digital Camera		
Siren		
Air Horn		
Bravo Flag		
Handheld radio(s)		
Cellular telephone(s)		
Remote Firing Device		
Sure fire Shock Cord initiator		
HR3-SS Non Electric Shock Cord Initiator		
Schonstedt (or equivalent) locator		
Shovel(s), round point, long handle		
Shovel(s), round point, short handle		
Tape, duct		
Tape, electrical		
Tape, measuring, 50 or 100 foot		
Galvanometer (if firing electric)		
Firing wire (if firing electric)		
Demolition Kit		
Knife		
Shock Cord Connectors		
Binoculars		
Other:		
Explosives		
Item	**Quantity**	**Comments**
Nonel		
Perforators (size)		
Detonating Cord		
Project Location:	*Project Number:*	
Demolition Supervisor Printed Name and Signature:		

Demolition Notification Checklist

Function	Phone	Date/Time	Initials
Senior Unexploded Ordinance (UXO) Supervisor			
Pre-Operation Notifications			
CB&I PM:	Landline: ____________ Cell: ____________	________ ________	
Client:	Landline: ____________ Cell: ____________	________ ________	
Security:	Landline: ____________ Cell: ____________	________ ________	
Range Control:	Landline: ____________ Cell: ____________	________ ________	
Medical:	Landline: ____________ Cell: ____________	________ ________	
Fire Department:	Landline: ____________ Cell: ____________	________ ________	
Range Control	Landline: ____________ Cell: ____________	________ ________	
Notice to Mariners if Required	Landline: ____________ Cell: ____________	________ ________	
Notice to Airman if Required	Landline: ____________ Cell: ____________	________ ________	
Local Public Officials if Required	Landline: ____________ Cell: ____________	________ ________	
Optional	Landline: ____________ Cell: ____________	________ ________	
Optional	Landline: ____________ Cell: ____________	________ ________	
Optional	Landline: ____________ Cell: ____________	________ ________	
Optional	Landline: ____________ Cell: ____________	________ ________	
Optional	Landline: ____________ Cell: ____________	________ ________	
Optional	Landline: ____________ Cell: ____________	________ ________	
Optional	Landline: ____________ Cell: ____________	________ ________	
Project Location:		Project Number:	
Senior UXO Supervisor Signature:		Date:	

MEC/MDEH Disposal Log

Project Information		
Project Name/Number:		
Project Location:		
Start Time:	Stop Time:	Date:

MEC Disposed of This Date: (List items and quantity of each)

Item	Quantity	NEW (lbs)

Donor Explosives Used (List types and quantity)

Item	Quantity	NEW (lbs)

Remarks:

Approval

Demolition Supervisor:	Date:

1. Carry blasting caps in approved containers and keep them out of the direct sun rays. Keep the caps located at least 25 feet (8 meters) from other explosives until they are needed for priming.

2. Do not work with electric blasting caps or other electro-explosive devices while wearing clothing prone to producing static electricity such as nylon, silk, synthetic hair, etc.

3. Do not use explosives or accessory equipment that is obviously deteriorated or damaged. They may cause premature detonation or fail completely.

4. Always point the explosive end of blasting caps, detonators, and explosive devices away from the body during handling.

5. Use only standard blasting caps of at least the equivalent of a commercial No. 8 blasting cap.

6. Use electric blasting caps of the same manufacturer for each demolition shot involving more than one cap.

7. Do not use improvised methods for initiating blasting caps.

8. Do not bury blasting caps. Use detonating cord to transmit the explosive wave from the blasting caps on the surface to a buried/tamped explosive charge. Buried blasting caps are subject to unobserved pressures and movement, which could lead to premature firing or misfires.

9. Test electric-blasting caps for continuity at least 50 feet (16 meters) from any other explosives prior to connecting them to the firing circuit. Upon completion of testing, the lead wires will be shunted by twisting the bare ends of the wires together. The wires will remain shunted until ready to be connected to the firing circuit.

10. In the event of a misfire when disposing of explosives by detonation, do not approach the disposal site for at least 60 minutes after the expected detonation time, when firing electrically. When conducting non-electric procedures, the wait time will be at least one hour from the expected time of detonation.

11. Items with lugs, strong backs, tail-booms, base plates, etc., should be oriented away from personnel locations.

12. Consideration should be given to tamping the unexploded ordinance (UXO) to control fragments, if the situation warrants. Fragments will be minimized not only to protect personnel but also property, such as buildings, trees, etc.

13. Avoid inhaling the smoke, dust or fumes of burning pyrotechnic or incendiary materials. The smoke, dust and fumes from many of these materials are irritating and/or toxic if inhaled.

14. Do not use water on incendiary fires. Water may induce a violent reaction or be completely ineffective, depending on the mixture.

15. Anticipate a high order detonation when burning pyrotechnic or incendiary-loaded MEC. Safety measures for personnel and property must be based upon this possibility.

16. Inert ordnance will not be disposed of or sold for scrap until the internal fillers have been exposed and unconfined. Heat generated during a reclamation operation can cause the inert filler, moisture, or air to expand and burst the sealed casings. Venting or exposure may be accomplished in any way necessary to preclude rupture due to pressure from being confined. All requirements of the UXO Procedure for the Management and Disposition of Material Potentially Presenting an Explosive Hazard (MPPEH) will be met prior to releasing any inert ordnance material.

17. Do not conduct blasting or demolition operations during an electrical, dust, sand or snowstorm severe enough to produce atmospheric static electrical charges, or when such a storm is nearby (within 10 miles (16 kilometers)). Under such conditions, all operations will be suspended or terminated, cap and lead wires shunted, and personnel removed from the demolition area. Demolition operations will also be terminated if visibility becomes less than 600 feet (185 meters).

18. Loose initiating explosives: lead azide, mercury fulminate, lead styphnate, and tetracene. These explosives manifest extreme sensitivity to friction, heat, and impact. Extra precautions are required when handling these types of explosives. Keep initiating explosives in a water-wet condition at all times until ready for final preparation for detonation. Sensitivity of these explosives is greatly increased when dry.
19. Exercise extreme care when handling and preparing high explosives for detonation. They are subject to detonation by heat, shock or friction.
20. Do not pack bomb fuze wells with explosives unless it can be positively confirmed that the fuze well does not contain any fuze components.
21. Photo flash bombs must be handled with the same care as black powder filled munitions.
22. MEC containing white phosphorous will not be detonated into the ground. White phosphorous munitions will be counter-charged on the bottom centerline (CCBC) when possible.
23. A search of the detonation site, after the demo operation, will be conducted to assure complete disposal was accomplished.
24. Do not abandon any explosives.
25. Do not leave explosives, empty cartridges, boxes, liners or other materials used in the packing of explosives anywhere children, unauthorized persons, or livestock can get to them.
26. Do not allow any wood, paper or other materials used in packing explosives to be burned in a stove, fireplace or other confined space or be re-used for any other purpose. Such materials will be destroyed by burning at an isolated location out of doors, with no one allowed within 100 feet (31 meters) of the burning operation.
27. Do not fight fires involving explosive material. Evacuate all personnel to a safe location and secure the area.
28. Know and observe federal, state, and local laws/regulations, which apply to the transportation, storage and use of explosives.
29. Do not permit metal, except approved metal truck bodies, to contact explosive containers.
30. Do not transport metal, flammable, or corrosive substances with explosives.
31. Do not allow smoking or the presence of unauthorized personnel in vehicles transporting explosives.
32. Carefully load and unload explosives from vehicles. Never throw or drop explosives from the vehicle.
33. Assure the load is blocked and braced to prevent it from movement and displacement.
34. Do not drive vehicles containing explosives over public highways until all permits and certifications have been obtained from the state enforcement agencies.
35. All routes must be approved in writing prior to transporting explosive materials over public highways.
36. Licensed commercial carriers will conduct the shipment of explosive materials over public highways unless CB&I UXO personnel have been specifically licensed and certified to make the shipment.
37. Never leave vehicle loaded with explosives unattended.
38. Do not store blasting caps, detonators, or other items containing initiating explosives in the same box, container or magazine with other explosives.

39. Store explosive materials in military or ATF approved magazines only. Ensure the magazines used for the storage comply with quantity distance requirements for the class of explosive material they contain. Reference documents include: OP-5, TM 9-1300-206, AMCR 385-100, ATF - Explosives Law and Regulation, ATF P 5400.7 and 49 CFR.

40. Do not store spark-producing metal/tools in an explosive magazine.

41. Do not permit smoking, matches or any source of fire or flame within 100 feet (31 meters) of an explosive magazine.

42. Do not allow leaves, grass, brush or debris to accumulate within 50 feet (16 meters) of an explosive magazine.

43. Do not permit the discharge of firearms within 300 feet (92 meters) of an explosive magazine.

44. Do not use any alkaline material such as lye, washing soda, or soap to remove TNT exudate. Alkaline materials will react with TNT to render it more sensitive.

45. Do not permit smoking, matches or other sources of fire or flame within 100 feet (31 meters) of an area in which explosives are being handled.

46. Do not expose explosives or devices containing explosive to prolonged exposure to direct sun light. Such exposure can increase sensitivity and deterioration.

47. Ensure all unused explosives are returned to their proper containers and the container closed after use.

48. Do not carry explosives or explosive components in pockets or on the body.

49. Do not insert anything but time fuse or detonating cord into the open end of a blasting cap.

50. Do not strike, tamper with, or attempt to remove or investigate the contents of an electric/non-electric blasting cap, detonator or other explosive initiating device. A detonation may occur.

51. Do not pull on the electrical lead wires of electric blasting caps, detonators or their electro-explosive devices. A detonation may occur.

52. Do not attempt to remove an unfired or misfired primer or blasting cap from a base coupling. There is a high risk of an explosion.

53. Do not allow unauthorized or unnecessary personnel to be present when explosives are being handled.

54. Always point the explosive end of blasting caps, detonators and other explosive devices away from the body.

55. Do not use pull rings or safety pins to lift or handle explosive devices.

56. Work involving priming devices and explosives shall be planned and organized so as to prevent injury or damage to personnel and surroundings. The main responsibility for such a task shall devolve upon one person. Among other things, this person shall ensure that all participants receive necessary information concerning the preconditions for the task and that explosives are handled and stored in a correct and safe manner.

57. If the main person responsible does not herself/himself participate in the work task (s)he shall appoint a deputy who thus also bears responsibility for the practical performance of the task.

58. Never handle damaged detonators. Undamaged detonators can be repacked in packages similar to original boxes.

60. Never use damaged products or partially damaged products (that have been shocked or submitted to excessive temperatures, etc.) During handling and transport of explosives only those personnel who are essential for the performance of the work involved shall be present.

61. Any explosive temporarily stored at a work site shall be protected against mechanical influences, heat, etc. that could conceivably cause unintentional detonation.

62. Different classes and types of dangerous goods shall be stored and transported separately.

63. To avoid the risk of unintentional injury and/or damage to surroundings, a triggering method that enables full control over the instant of detonation is recommended. The firing system shall initiate the charge reliably and immediately upon triggering.

64. When triggering exposed firing systems (detonators and surface connectors), ensure that they cannot cause injury or damage to property. As a guideline, there should be a safety distance of at least 65 feet (20 meters).

65. Damaged, undetonated detonators are safety hazards and shall be handled with the utmost care. If possible, they should be neutralized *in situ* by being blasted to destruction by an explosive charge. Damaged, undetonated detonators shall under no circumstances be put together with other explosive goods in any way.

66. Handle with care, avoid all forms of commotion, impact and friction on products and their packages, and keep products and packages away from heat, flames and sparks.

67. Keep far from children.

68. The control and implementation of pyrotechnic articles must be done by authorized staff.

69. For shock tube only, consider initial isolation of at least 50 feet (16 meters) in all directions.

70. Fight fire with normal precautions and methods used for plastic fires from a reasonable distance. **IF DETONATORS OR OTHER EXPLOSIVES ARE PRESENT, DO NOT FIGHT FIRE.**

I have read, understand, and agree to follow the General Demolition Safety Precautions.

Printed Name	Signature	Representing	Date

Magazine Inspection Checklist

Project Information

Project Name: ______________________________ **Date:** ______________

Location: ______________________________ **CTO Number:** ________

Project Number: ______________________________

Inspection Checklist Items (Check items complete)

Inspected by: ______________________________

- c Ensure the area around the magazine is free of debris, flammable materials, and tall vegetation
- c Ensure the general magazine is in good condition (doors, ventilation, locks)
- c Check for signs of unauthorized entry (locks, fence, structural damage, etc.)
- c Ensure items in the magazine are properly stored (check separation, aisle space and stacks)
- c Ensure no fire hazards are present (fire breaks, dry vegetation, firefighting equipment, etc.)
- c Ensure lightning protection is in place and properly configured
- c Confirm the compatibility of magazine contents
- c Check for unusual odors, abnormal temperatures, or leaking materials
- c Ensure that placards and warning notices are posted (including NEW limits)
- c Ensure that safety information is posted
- c Ensure first aid equipment is present at the identified location near the magazine

Comments (Note any actions needed or taken)

____

____

____

____

Verification of Completion

Senior Unexploded Ordinance Supervisor Signature ______________________ Date ______________

Unexploded Ordinance Quality Control Supervisor Signature ______________________ Date ______________

Magazine Inventory Card

1. Project Name, Location:	2. Project Number:	3. Explosive Manufacturer	4. Marks of Identification:
5. Storage Location:	**6. Explosive Description:**		

7. Date	8. Action/Purpose	9. Qty In	10. Qty Out	11. Balance	12. Printed Name	13. Signature

Documentation of Receipt/Disposal of Explosives

1. Project Name, Location	2. Project Number	3. Explosive Manufacturer	4. Marks of Identification
5. Storage Location	**6. Explosive Description**		
7. Name, Address, and License Number of Vendor			

8. Date	9. Quantity Received	10. Date of Final Disposal	11. Date of Noted Discrepancy	12. Balance	13. Printed Name	14. Signature
Comments:						

This form must be completed within 24 hours of receipt and final disposal of explosives.

The original and copies of this form must be distributed as follows:

- Original to project file
- Copy to project PBA
- Copy to project SCA
- Copy to the Executive Assistant

INERT/DEMILIZATIZATION/CHAIN OF CUSTODY CERTIFICATION for Nonhazardous Munitions Debris/Range Residue Scrap

Load No.

GENERAL

1. Releasing Generators (RG) Name and Mailing Address	1a. RG's Phone No.	2. RG's Site Manager
3. Releasing Generators (RG) Project Name and Location	3a. RG Project Phone No.	4. RG's SUXOS
5. Transporter Name and Mailing Address	5a. Transporter Phone No.	6. Dispatcher Name

RELEASING GENERATOR

7. Processor/Recycler/Demilitarization – Qualified Recycler		7a. QR Phone No.	8. QRQC's Manager

9. Box No.	10. Seal Nos.	11. Gross Weight	12. Tare Weight	13. Net Weight

14. Description	15. Material Type	16. Units (Wt, Volume)

Inert Certification: "**This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials**"

17. Inspector/Certified Project UXO/QC

Print/Type Name	Signature	Month/Date Year ______/______/______

18. Inspector/Certifier Site Senior UXP Supervisor (SUXOS)

Print/Type Name	Signature	Month/Date Year ______/______/______

19. Material Released to the Transport By RG's Site Manager

RELEASED BY: Print/Type Name	Signature	Month/Date Year ______/______/______

TRANSPORTER

20. Transporter: I ACKNOWLEDGE THE RECEIPT OF MATERIAL (Receiving Signature Verifies that Seals are Intact)

RECEIVED BY: Print/Type Name/Company	Signature	Month/Date Year ______/______/______

21. Material Released by Transporter

RELEASED BY: Print/Type Name/Company	Signature	Month/Date Year ______/______/______

RECEIVING PROCESSOR – RECYCLER

22. Storage Manager: I ACKNOWLEDGE THE RECEIPT OF MATERIAL (Receiving Signature Verifies that Seals are Intact)

RECEIVED BY: Print/Type Name/Company	Signature	Month/Date Year ______/______/______

23. Material Released CRRRT to new CRRRT (if needed)

RELEASED BY: Print/Type Name	Signature	Month/Date Year ______/______/______

24. Current CRRRT: I ACKNOWLEDGE THE RECEIPT OF MATERIAL

RECEIVED BY: Print/Type Name	Signature	Month/Date Year ______/______/______

Demilitarization/Destruction Certification: "I CERTIFY THAT EACH ITEM OR ITEMS LISTED HEREON WERE DEMILITARIZED/DESTROYED, SO AS TO NO LONGER RESEMBLE MUNITIONS/ORDNANCE, BEYOND THE REQUIREMENTS LISTED IN DoD 4160.21-M-1."

25. Qualified Recycling Manager

Print/Type Name	Signature	Month/Date Year ______/______/______

26. List Discrepancy Indication Here

Uncontrolled when printed: Verify latest version on ShawNet/Governance

GENERAL	INERT/DEMILIZATIZATION/CHAIN OF CUSTODY CERTIFICATION for Nonhazardous Munitions Debris/Range Residue Scrap				Load No.
	1. Releasing Generators (RG) Name and Mailing Address		1a. RG's Phone No.		2. RG's Site Manager
	3. Releasing Generators (RG) Project Name and Location		3a. RG Project Phone No.		4. RG's SUXOS
	5. Transporter Name and Mailing Address		5a. Transporter Phone No.		6. Dispatcher Name
RELEASING GENERATOR	7. Processor/Recycler/Demilitarization – Qualified Recycler		7a. QR Phone No.		8. QRQC's Manager
	9. Box No.	10. Seal Nos.	11. Gross Weight	12. Tare Weight	13. Net Weight
	14. Description	15. Material Type		16. Units (Wt, Volume)	
	Inert Certification: "**This certifies that the material listed has been 100 percent properly inspected and, to the best of our knowledge and belief, are free of explosive hazards, engine fluids, illuminating dials and other visible liquid HTRW materials**"				
	17. Inspector/Certified Project UXO Site Senior UXO Supervisor (SUXOS)				
	Print/Type Name	Signature		Month/Date Year ____/____/____	
	18. Inspector/Certifier OESS or Designated Certifier				
	Print/Type Name	Signature		Month/Date Year ____/____/____	
	19. Material Released to the Transport By RG's Site Manager				
	RELEASED BY: Print/Type Name	Signature		Month/Date Year ____/____/____	
TRANSPORTER	20. Transporter: I ACKNOWLEDGE THE RECEIPT OF MATERIAL (Receiving Signature Verifies that Seals are Intact)				
	RECEIVED BY: Print/Type Name/Company	Signature		Month/Date Year ____/____/____	
	21. Material Released by Transporter				
	RELEASED BY: Print/Type Name/Company	Signature		Month/Date Year ____/____/____	
RECEIVING PROCESSOR – RECYCLER	22. Storage Manager: I ACKNOWLEDGE THE RECEIPT OF MATERIAL (Receiving Signature Verifies that Seals are Intact)				
	RECEIVED BY: Print/Type Name/Company	Signature		Month/Date Year ____/____/____	
	23. Material Released CRRRT to new CRRRT (if needed)				
	RELEASED BY: Print/Type Name	Signature		Month/Date Year ____/____/____	
	24. Current CRRRT: I ACKNOWLEDGE THE RECEIPT OF MATERIAL				
	RECEIVED BY: Print/Type Name	Signature		Month/Date Year ____/____/____	
	Demilitarization/Destruction Certification: "I CERTIFY THAT EACH ITEM OR ITEMS LISTED HEREON WERE DEMILITARIZED/DESTROYED, SO AS TO NO LONGER RESEMBLE MUNITIONS/ORDNANCE, BEYOND THE REQUIREMENTS LISTED IN DoD 4160.21-M-1."				
	25. Qualified Recycling Manager				
	Print/Type Name	Signature		Month/Date Year ____/____/____	
	26. List Discrepancy Indication Here				

	Title: Electric Misfire Procedures Checklist	Date:___________ Time:___________

Uncontrolled when printed:

1. Check the continuity of the firing wire system with the Galvanometer.
   a. ___ If there is continuity re connect the firing wire to the blasting machine and attempt to fire the system.
   b. ___ If the system again fails, go to step d.
   c. ___ If there is no continuity, go to step d.
   d. ___Wait 60 Minutes.
   e. ___ After 60 minutes the demolition supervisor with one additional UXO Technician to act as safety will travel down range inspecting the firing system.

2. If the electric caps failed to function;
   a. ____ Disconnect the original caps and shunt.
   b. ____Check the firing wire with a Galvanometer.
   c. ____ Place a new set of electric caps.
   d. ____ Leave the old caps on the shot.
   e. ____ Return to the safe area.

3. If the electric caps functioned;
   a. ____ Shunt the functioned Caps
   b. ____ Check the firing wire with a Galvanometer.
   c. ____ Place a new set of electric caps.
   d. ____ Return to the safe area.

Demo Supervisor Signature___________________

Appendix E
MSD Calculation Sheets

Fragmentation Data Review Form

Database Revision Date 4/2/2012

Category:	Surface-Launched HE Rounds
Munition:	105 mm M1 (TNT filled)
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Projectile
Munition Case Classification:	Robust

DODIC:	C445
Date Record Created:	1/27/2011
Record Created By:	SDH
Last Date Record Updated:	
Individual Last Updated Record:	
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	TNT
Explosive Weight (lb):	4.6
Diameter (in):	4.1340
Cylindrical Case Weight (lb):	18.15800
Maximum Fragment Weight (Intentional) (lb):	0.2648
Design Fragment Weight (95%) (Unintentional) (lb):	0.0818
Critical Fragment Velocity (fps):	4345

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	4.600
Kinetic Energy 10^6 (lb-ft²/s²):	2.4216

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	36
Expected Max. Throw Distance (ft):	220
Minimum Separation Distance (ft):	220

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	275.000
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	300
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	2111
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1637

Overpressure Distances

TNT Equivalent (Pressure):	1
TNT Equivalent Weight - Pressure (lbs):	4.600
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	30
Public Traffic Route Distance (2.3 psi); K24 Distance:	40
Inhabited Building Distance (1.2 psi), K40 Distance:	67
Intentional MSD (0.0655 psi), K328 Distance:	545

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	10.01	5.05
Mild Steel:	1.93	0.98
Hard Steel:	1.58	0.80
Aluminum:	3.80	1.98
LEXAN:	8.71	5.89
Plexi-glass:	7.18	4.27
Bullet Resist Glass:	6.37	3.61

Item Notes

Distribution authorized to the Department of Defense and U.S. DoD contractors only for Administrative-Operational Use (17 October 2002). Other requests shall be referred to the Chairman, Department of Defense Explosives Safety Board, Room 856C, Hoffman Building I, 2461 Eisenhower Avenue, Alexandria, VA 22331-0600.

Fragmentation Data Review Form

Database Revision Date 4/2/2012

Category:	Surface-Launched HE Rounds
Munition:	105 mm M393A3
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Projectile
Munition Case Classification:	Robust

DODIC:	C429
Date Record Created:	6/2/2011
Record Created By:	SDH
Last Date Record Updated:	9/14/2011
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition A-3
Explosive Weight (lb):	6.6
Diameter (in):	4.1400
Cylindrical Case Weight (lb):	18.19100
Maximum Fragment Weight (Intentional) (lb):	0.2000
Design Fragment Weight (95%) (Unintentional) (lb):	0.0361
Critical Fragment Velocity (fps):	4121

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1.08
TNT Equivalent Weight - Impulse (lbs):	7.128
Kinetic Energy 10^6 (lb-ft²/s²):	1.6986

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	24
Expected Max. Throw Distance (ft):	125
Minimum Separation Distance (ft):	200

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	275.000
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	337
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	1933
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1495

Overpressure Distances

TNT Equivalent (Pressure):	1.09
TNT Equivalent Weight - Pressure (lbs):	7.194
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	35
Public Traffic Route Distance (2.3 psi); K24 Distance:	46
Inhabited Building Distance (1.2 psi), K40 Distance:	77
Intentional MSD (0.0655 psi), K328 Distance:	633

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	9.74	4.31
Mild Steel:	1.77	0.84
Hard Steel:	1.46	0.69
Aluminum:	3.59	1.73
LEXAN:	7.96	5.24
Plexi-glass:	6.38	3.66
Bullet Resist Glass:	5.59	3.02

Item Notes

Fragmentation Data Review Form

Database Revision Date 4/2/2012

Category:	Surface-Launched HE Rounds
Munition:	2.75 in M229 Rocket
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Rocket
Munition Case Classification:	Robust

DODIC:	H469
Date Record Created:	9/21/2004
Record Created By:	MC
Last Date Record Updated:	9/14/2011
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition B
Explosive Weight (lb):	4.8
Diameter (in):	2.7500
Cylindrical Case Weight (lb):	11.43700
Maximum Fragment Weight (Intentional) (lb):	0.0564
Design Fragment Weight (95%) (Unintentional) (lb):	0.0062
Critical Fragment Velocity (fps):	5773

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1.14
TNT Equivalent Weight - Impulse (lbs):	5.472
Kinetic Energy 10^6 (lb-ft²/s²):	0.9406

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	24
Expected Max. Throw Distance (ft):	125
Minimum Separation Distance (ft):	200

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	200.000
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	308
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	1434
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1135

Overpressure Distances

TNT Equivalent (Pressure):	1.16
TNT Equivalent Weight - Pressure (lbs):	5.568
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	32
Public Traffic Route Distance (2.3 psi); K24 Distance:	43
Inhabited Building Distance (1.2 psi), K40 Distance:	71
Intentional MSD (0.0655 psi), K328 Distance:	581

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	7.78	3.16
Mild Steel:	1.45	0.61
Hard Steel:	1.19	0.50
Aluminum:	2.96	1.30
LEXAN:	7.04	4.11
Plexi-glass:	5.41	2.65
Bullet Resist Glass:	4.58	2.07

Item Notes

Fragmentation Data Review Form

Database Revision Date 4/2/2012

Category:	Surface-Launched HE Rounds
Munition:	90 mm M71
Case Material:	Steel, Mild
Fragmentation Method:	Naturally Fragmenting
Secondary Database Category:	Projectile
Munition Case Classification:	Robust

DODIC:	C266
Date Record Created:	9/21/2004
Record Created By:	MC
Last Date Record Updated:	3/31/2011
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition B
Explosive Weight (lb):	1.68
Diameter (in):	3.5430
Cylindrical Case Weight (lb):	15.77000
Maximum Fragment Weight (Intentional) (lb):	0.3112
Design Fragment Weight (95%) (Unintentional) (lb):	0.0714
Critical Fragment Velocity (fps):	2692

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1.14
TNT Equivalent Weight - Impulse (lbs):	1.915
Kinetic Energy 10^6 (lb-ft²/s²):	1.1275

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	24
Expected Max. Throw Distance (ft):	125
Minimum Separation Distance (ft):	200

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Not Permitted
Expected Max. Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Water Mitigation

Minimum Separation Distance (ft):	200.000
Water Containment System:	1100 gal tank

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	288
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	1939
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1443

Overpressure Distances

TNT Equivalent (Pressure):	1.16
TNT Equivalent Weight - Pressure (lbs):	1.949
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	22
Public Traffic Route Distance (2.3 psi); K24 Distance:	30
Inhabited Building Distance (1.2 psi), K40 Distance:	50
Intentional MSD (0.0655 psi), K328 Distance:	410

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	6.68	3.75
Mild Steel:	1.30	0.71
Hard Steel:	1.07	0.58
Aluminum:	2.61	1.47
LEXAN:	7.01	4.90
Plexi-glass:	5.40	3.35
Bullet Resist Glass:	4.75	2.79

Item Notes

Fragmentation Data Review Form

Database Revision Date 4/2/2012

Category:	Non-Fragmenting Rounds
Munition:	40 mm M407 Practice
Case Material:	Aluminum 7075
Fragmentation Method:	Non-Fragmenting
Secondary Database Category:	
Munition Case Classification:	Non-Fragmenting

DODIC:	B577
Date Record Created:	11/17/2011
Record Created By:	SDH
Last Date Record Updated:	
Individual Last Updated Record:	
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	RDX
Explosive Weight (lb):	0.01323
Diameter (in):	1.5700
Cylindrical Case Weight (lb):	
Maximum Fragment Weight (Intentional) (lb):	
Design Fragment Weight (95%) (Unintentional) (lb):	
Critical Fragment Velocity (fps):	

Sandbag and Water Mitigation Options

TNT Equivalent (Impulse):	1.3000
TNT Equivalent Weight - Impulse (lbs):	0.017
Kinetic Energy 10^6 (lb-ft²/s²):	

Single Sandbag Mitigation

Required Wall & Roof Thickness (in)	Non-Fragmenting
Expected Max. Throw Distance (ft):	Non-Fragmenting
Minimum Separation Distance (ft):	Non-Fragmenting

Double Sandbag Mitigation

Required Wall & Roof Thickness (in)	Non-Fragmenting
Expected Max. Throw Distance (ft):	Non-Fragmenting
Minimum Separation Distance (ft):	Non-Fragmenting

Water Mitigation

Minimum Separation Distance (ft):	Non-Fragmenting
Water Containment System:	Non-Fragmenting

Note: Use Sandbag and Water Mitigation in accordance with all applicable documents and guidance. If a donor charge larger than 32 grams is utilized, the above mitigation options are no longer applicable. Subject matter experts may be contacted to develop site specific mitigation options.

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	
MFD-V [Maximum Fragment Distance, Vertical] (ft):	

Overpressure Distances

TNT Equivalent (Pressure):	1.46
TNT Equivalent Weight - Pressure (lbs):	0.019
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	5
Public Traffic Route Distance (2.3 psi); K24 Distance:	6
Inhabited Building Distance (1.2 psi), K40 Distance:	11
Intentional MSD (0.0655 psi), K328 Distance:	88

Note: Per V5.E3.2.2.1 of DoD 6055.09-M the minimum sited K328 distance may be no smaller than 200 ft.

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):		
Mild Steel:		
Hard Steel:		
Aluminum:		
LEXAN:		
Plexi-glass:		
Bullet Resist Glass:		

Item Notes

Appendix F
Resumes

Last Updated: 02 Apr 2014

Alexander E. Smith

Professional Qualifications

Mr. Smith is a Registered Professional Geologist with more than 14 years of experience conducting and managing projects associated with investigation and remediation of a variety of environmental contaminants, including organic and inorganic compounds and unexploded ordnance (UXO). He has managed UXO removal actions and other projects, valued at greater than $1 million, and has served as site manager with responsibility for as many as 30 site personnel. Mr. Smith's regulatory experience includes Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation Recovery Act (RCRA), and Toxic Substances Control Act (TSCA). He has extensive experience in the complete CERCLA process ranging from preliminary assessment/site inspection (PA/SI), through remedial investigation/feasibility study (RI/FS), to proposed plan and record of decision.

Currently, Mr. Smith is a Geologist and Project Manager, supporting projects for the U.S. Army Corps of Engineers, U.S. Army Environmental Center, and the U.S. Department of Agriculture.

Education

Bachelor of Science, Geology, University of Maryland, College Park, Maryland, 1992

Additional Training/Continuing Education

8-Hour OSHA Refresher, Shaw Environmental, 2008
Cardiopulmonary Resuscitation (CPR), American Red Cross, 2008
Princeton Groundwater Pollution and Hydrology Course, Princeton Groundwater, Inc., 2008
Standard First Aid, American Red Cross, 2007
OSHA 10-Hour Construction Safety, Shaw Environmental, 2004
U.S. Army Corps of Engineers Construction Quality Management for Contractors, Baltimore District, 1997
OSHA Hazardous Waste Operations Supervisor Training, Louis Berger & Associates, 1995
40-Hour Hazardous Waste Operations and Emergency Response Training (29CFR1910.120), HAZMAT TSI, 1994
Environmental Drilling, Well Installation & Sampling for Site Characterization and Monitoring, The Nielsen Environmental Field School, 1994

Registrations/Certifications/Licenses

Professional Geologist, 2003, S4-000, Active, Delaware, 10/2008

Experience and Background

05/2002 - Present
Project Manager, Shaw Environmental & Infrastructure, Inc., Federal Services, Edgewood, Maryland

Responsibilities include the overall direction and coordination of project personnel to meet safety, quality, budget, and schedule requirements. Also responsible for business development, staffing, and proposals.
Recent assignments have included:

The following is a summary of key projects:
<u>Project Manager, Fort Belvoir - MMRP Remedial Investigations and Munitions Response, 136956, U.S. Army Corps of Engineers, Baltimore District, Fort Belvoir, VA, $3,665,917.00, 08/2009 - Present</u>
Project includes CERCLA investigations for eight MMRP sites that include small arms ranges, demolition training ranges, artillery ranges, and maneuvers training areas. Investiational approach determined through TPP meetings with stakeholders, including Virginia DEQ and EPA Region 3. Performance Objectives include Remedial Investigation, with two sites also proceeding to Remedy in Place. One of the MMRP sites includes a 36-acre removal action for land mines and booby traps. Managed personnel performing geophysical investigations, anomaly excavations, disposal of MEC and MD, and MC sampling.

Accomplishments:
Project is on schedule with a client Quality Assurance rating of "Excellent".

<u>Project Manager, Plum Tree Island Range FUDS, 132662, U.S. Army Corps of Engineers, Baltimore District, Poquoson, Virginia, $2,406,281.00, 06/2008 - Present</u>
Plum Tree Island Range is a 3,276 acre salt marsh formerly used as a bombing range. The marsh is currently a wildlife refuge belonging to the U.S. Fish and Wildlife Service (USFWS). Scope of work included performing a Remedial Investigation/ Feasibility Study of the property for MEC and MC hazards, and selecting a remedy through the CERCLA process.

Successfully shepherded Shaw's sampling approach through the Technical Project Planning (TPP) process with stakeholders, including the USFWS, State of Virginia Department of Environmental Quality (DEQ), EPA Region 3, and City of Poquoson. Explained rationale for Shaw's approach and addressed state regulator concerns to gain consensus, and laid groundwork for acceptance of this sampling approach at other sites in Virginia. Removed approximately 8 tons of munitions debris to clear approximately 123 acres of shoreline of MEC hazards. Managed use of digital geophysical mapping that included 39 miles of DGM transects and 7.5 acres of DGM grids. Excavated geophysical anomalies and disposed of MEC and MD. Conducted MC sampling and assessed MEC hazards and MC risks.

Accomplishments:
Developed a towable DGM system using an amphibious vehicle and floating platform, that was capable of negotiating all marsh terrain from dry land to open water.

Awards/Client Commendations:
Managed TPP process earning praise from Virginia DEQ's Eric Salopek who commended his "excellent presentation".

Other Comments:
No Comments

Project Manager, Building 700 Motor Pool BRAC Investigation, Fort Ritchie, 124144 and 139777, U.S. Army Corps of Engineers, Baltimore District, Former Fort Ritchie, Cascade, Maryland, $300,000.00, 09/2006 - Present
Developed long-term monitoring programs for groundwater and land-use controls for a site contaminated by chlorinated solvents in groundwater. The site was part of a Base Realignment and Closure (BRAC) facility, and was remediated through the CERCLA process with sodium permanganate addition. Annual groundwater sampling is performed as well as a CERCLA 5-year review.

Accomplishments:
Project is on schedule and the client is satisfied such that follow on work is awarded.

05/2002 - Present
Geologist, Shaw Environmental & Infrastructure, Inc., Federal Services, Edgewood, Maryland

Responsibilities include providing support to client projects and office staff as a technical consultant. Also responsible for business development, preparing technical reports and proposals. Recent assignments have included:

The following is a summary of key projects:
Project Geologist, Building 700 Motor Pool, 866708 and 866725, U.S. Army Corps of Engineers, Baltimore District, Fort Ritchie, Maryland, 05/2002 - Present
As Project Geologist, provided technical review during the development of work plans and reports for characterization and cleanup of a site contaminated by chlorinated solvents in groundwater. Investigation included the delineation of contaminants in groundwater and soil using multiple screening tools including passive soil gas survey and direct push groundwater screening. Oversaw the installation of monitoring wells, addition wells, and piezometers to monitor contaminant levels and the piezometric surface and determine the interaction between groundwater and two lakes. Remediation conducted via a multi-phased approach of sodium permanganate treatment through the saturated and vadose zones.

Awards/Client Commendations:
Shaw was commended by the Army five separate times for its work at Fort Ritchie, specifically commending Mr. Smith's contributions to the project. The most recent commendation was received in 2007 at the completion of the project. The following quote is from a March 15, 2007 letter from William D. Hofmann, Environmental and Transition Coordinator, Base Realignment and Closure Office: "It is again with great pleasure that I send you this letter of thanks for all your company has done for me, Fort Ritchie and the Department of the Army. As the active cleanup and transfer of Fort Ritchie comes to an end, I would again like to recognize Mr. Alexander Smith for his dedication to the environmental investigation, removal actions, and documentation associated with the Base Realignment and Closure, and transfer efforts at Fort Ritchie. His recent efforts associated with the Motor Pool cleanup and UXO removal have been commendable. He has consistently produced quality products in a timely manner, and routinely met stringent Army and regulatory requirements. Alex and his team continued to provide exceptional service to the Army; for which I am extremely grateful. Please extend my appreciation to Alex, and the associated Shaw staff, for a job well-done and continued success in the future."

05/2002 - Present
Project Manager, Shaw Environmental & Infrastructure, Inc., Federal Services, Edgewood, Maryland

Responsibilities include the overall direction and coordination of project personnel to meet safety, quality, budget, and schedule requirements. Also responsible for business development, staffing, and proposals.
Recent assignments have included:

The following is a summary of key projects:
Project Manager, Building 700 Motor Pool BRAC Investigation, Fort Ritchie, 866708, U.S. Army Corps of Engineers, Baltimore District, Fort Ritchie, Maryland, 05/2002 - 01/2007
Managed the investigation and remedial decision process for a site contaminated by chlorinated solvents in groundwater. The site was part of a Base Realignment and Closure (BRAC) facility, and was taken through the CERCLA process, including a Site Investigation, Remedial Investigation, Removal Action, Feasibility Study, Proposed Plan, and Record of Decision. All phases of the process were completed with close coordination with a BRAC cleanup team consisting of the Army, EPA, and Maryland Department of the Environment (MDE). Because the property was to be transferred out of the government prior to achieving cleanup levels, the remedial action was demonstrated to the EPA to be Operating Properly and Successfully (OPS).

Awards/Client Commendations:
Shaw was commended by the Army five separate times for its work at Fort Ritchie, specifically commending Mr. Smith's contributions to the project. The most recent commendation was received in 2007 at the completion of the project. The following quote is from a March 15, 2007 letter from William D. Hofmann, Environmental and Transition Coordinator, Base Realignment and Closure Office: "It is again with great pleasure that I send you this letter of thanks for all your company has done for me, Fort Ritchie and the Department of the Army. As the active cleanup and transfer of Fort Ritchie comes to an end, I would again like to recognize Mr. Alexander Smith for his dedication to the environmental investigation, removal actions, and documentation associated with the Base Realignment and Closure, and transfer efforts at Fort Ritchie. His recent efforts associated with the Motor Pool cleanup and UXO removal have been commendable. He has consistently produced quality products in a timely manner, and routinely met stringent Army and regulatory requirements. Alex and his team continued to provide exceptional service to the Army; for which I am extremely grateful. Please extend my appreciation to Alex, and the associated Shaw staff, for a job well-done and continued success in the future."

Project Manager, Fort Ritchie MEC Removal Action, 800478, U.S. Army Corps of Engineers, Fort Ritchie, Maryland, $9,000,000.00, 05/2000 - 06/2006
Mr. Smith began this project as a Task Manager and later became Project Manager in January 2005. The project included removal of unexploded ordnance (UXO) over approximately 250 acres of former firing ranges. Tasks included developing comprehensive work plans and a Department of Defense Explosives Safety Submission (ESS) to specify the detailed procedures for safely locating, investigating, and disposing of UXO. Geophysical investigations were performed either by EOD-trained personnel using traditional magnetometer equipment or by geophysical technicians using state-of-the-art geophysical detection technologies and navigation tools such as electromagnetic (EM) instruments, GPS, and robotic total station (RTS). Assisted in the development of new quality control requirements for using EM equipment to clear UXO, especially in areas subject to metallic cultural interference and abundant non-ordnance scrap material. Provided overall site management of geophysical teams, UXO teams, land surveyors,

site restoration crews, and data management personnel. Provided daily communication with the client, the facility, sub-contractors, and other agencies, and conducted weekly progress meetings.

Accomplishments:
The originally scoped area to be remediated was completed approximately 2 years ahead of schedule.

Awards/Client Commendations:
Shaw was commended by the Army five separate times for its work at Fort Ritchie, specifically commending Mr. Smith's contributions to the project. The most recent commendation was received in 2007 at the completion of the project. The following quote is from a March 15, 2007 letter from William D. Hofmann, Environmental and Transition Coordinator, Base Realignment and Closure Office: "It is again with great pleasure that I send you this letter of thanks for all your company has done for me, Fort Ritchie and the Department of the Army. As the active cleanup and transfer of Fort Ritchie comes to an end, I would again like to recognize Mr. Alexander Smith for his dedication to the environmental investigation, removal actions, and documentation associated with the Base Realignment and Closure, and transfer efforts at Fort Ritchie. His recent efforts associated with the Motor Pool cleanup and UXO removal have been commendable. He has consistently produced quality products in a timely manner, and routinely met stringent Army and regulatory requirements. Alex and his team continued to provide exceptional service to the Army; for which I am extremely grateful. Please extend my appreciation to Alex, and the associated Shaw staff, for a job well-done and continued success in the future."

05/2002 - Present
Geologist, Shaw Environmental & Infrastructure, Inc., Federal Services, Edgewood, Maryland

Responsibilities include providing support to client projects and office staff as a technical consultant. Also responsible for business development, preparing technical reports and proposals. Recent assignments have included:

The following is a summary of key projects:
<u>Task Manager and Project Geologist, ST-14, Andrews Air Force Base, 827590, U.S. Air Force, Andrews Air Force Base, Maryland, 07/2004 - 02/2006</u>
Oversaw the development of an addendum to the Comprehensive Environmental Investigation Report for site ST-14, which delineated the extent of petroleum, TCE, and carbon tetrachloride contamination in an industrial area of the base. The addendum included the results of groundwater, soil, surface water, sediment, and geotechnical sampling, and evaluated the data in ecological and human health risk assessments. An important element of the report was the justification of a conceptual site model that included a geologic barrier to downward contaminant migration.

05/2002 - Present
Project Manager, Shaw Environmental & Infrastructure, Inc., Federal Services, Edgewood, Maryland

Responsibilities include the overall direction and coordination of project personnel to meet safety, quality, budget, and schedule requirements. Also responsible for business development, staffing, and proposals.
Recent assignments have included:

The following is a summary of key projects:
Project Manager, Soil Stabilization of 25-Yard Gun Range, 111218, U.S. Department of Agriculture, Beltsville Agricultural Research Center, Beltsville, Maryland, $50,000.00, 09/2004 - 07/2005
As Project Manager, oversaw the development of work plans to perform stabilization of lead in soil at a 25-yard gun range. Tasks include work plan development, sampling of soil and surface water runoff, site grading, in-situ application of rock phosphate stabilizer and compost, confirmation sampling, and site restoration.

Accomplishments:
Successfully completed the project within budget and on schedule.

Project Manager, Beltsville Agricultural Research Center, Public Health Assessment Response Action, 100233, U.S. Department of Agriculture, Beltsville, Maryland, $100,000.00, 10/2003 - 07/2005
As Project Manager, oversaw the field investigations and desktop studies to respond to Public Health Assessment (PHA) recommendations from the Agency for Toxic Substances and Disease Registry (ATSDR). Tasks included sampling of groundwater from private residences and production wells; modeling and evaluating human health risk from the consumption of fish based on surface water and sediment data; identifying areas of concern that are accessible by the public and may pose a hazard; and identifying water and sewer lines in contaminated areas of concern that may potentially transport contaminants.

Accomplishments:
Successfully completed the project under budget and on schedule.

Task Manager, Fort Detrick RI/FS, 840549, U.S. Army Corps of Engineers, Baltimore District, Fort Detrick, Frederick, Maryland, $651,949.00, 01/2003 - 01/2005
As Task Manager, oversaw the development of work plans/reports and coordinated periodic groundwater and surface water sampling events for two separate TCE/PCE release sites in karst aquifers. Coordinated soil sampling and geophysical investigations and provided oversight for analysis and reporting to complete the characterization of five sites in preparation for site close-out. Managed personnel and budget and performed monthly reporting.

Accomplishments:
Successfully completed all soil sampling activities and eight of eleven rounds of groundwater and surface water monitoring. Achieved closeout of the first of five sites. All work has been within schedule and budget.

12/1996 - 05/2002
Geologist, IT Corporation, Edgewood, Maryland

Responsibilities include providing support to client projects and office staff as a technical consultant. Also responsible for business development, preparing technical reports and proposals. Recent assignments have included:

The following is a summary of key projects:
Project Geologist, Fort Ritchie Site Investigation and Cleanup, 866708, US Army Corps of Engineers, Baltimore District, Fort Ritchie, Maryland, 12/1996 - 05/2002
As Project Geologist, developed plans and implemented environmental site characterization activities and analyses for sixteen operable units, as documented in a site investigation report.

Developed a subsequent feasibility study for OU10 - Wise Road Disposal Area. Developed EE/CAs and performed removal actions for OU2 - Incinerator Area, OU5 - DPW Equipment Area, OU14 - Former Burn Area, and OU15 - Reservoir Road Waste Disposal Area. Assisted in the development of remedial decisions and developed decision documents for OU1 - Golf Course Maintenance Shop, OU3 - Lake Royer and Lake Wastler, OU6 - Autocraft Shop, OU7 - Abandoned Firing Ranges, OU8 - Post Exchange Service Station, OU9 - Administration Building Area, OU11 - Wetlands Area, OU12 - Former Hospital Area, and OU16 - Electrical Substation.

Geologist, Site-Wide Ordnance and Explosives Work Plan, Former Fort Ord, U.S. Army Corps of Engineers, Sacramento District, Fort Ord, California, 05/2000 - 09/2000
Developed a comprehensive work plan specifying the detailed procedures used to safely avoid, locate, investigate, and dispose of unexploded ordnance (UXO) for the entire BRAC facility. Reviewed and compiled historical site data, researched and incorporated regulatory and contractual requirements regarding UXO avoidance procedures, UXO detection methods, statistical sampling, explosives storage and siting, UXO excavation and investigation, UXO disposal, OE scrap handling and disposal, site safety and health, quality control, location surveying and mapping, environmental protection, and geographical information systems.

12/1996 - 05/2002
Task Manager, IT Corporation (The Shaw Group Inc. acquired substantially all of the operating assets of The IT Group, Inc., on May 23, 2002), Federal Services, Edgewood, Maryland

Responsibilities include the overall direction and coordination of project personnel to meet safety, quality, budget, and schedule requirements. Also responsible for business development, staffing, and proposals.
Recent assignments have included:

The following is a summary of key projects:
Task Manager, Fort Ritchie Ordnance and Explosives Site EE/CA, 866708, U.S. Army Corps of Engineers, Fort Ritchie, Maryland, 03/1997 - 11/1999
Developed comprehensive work plans to investigate the nature and extent of unexploded ordnance (UXO) remaining on former training ranges. Compiled and statistically analyzed UXO sampling data and calculated risk values. Proposed and evaluated alternative cleanup strategies and presented all findings and conclusions in an EE/CA report. Geophysical investigations were performed either by EOD-trained personnel using traditional magnetometer equipment or by geophysical technicians using electromagnetic (EM) instruments. Provided overall site management of geophysical teams, UXO teams, land surveyors, site restoration crews, and data management personnel. Provided daily communication with the client, the facility, sub-contractors, and other agencies, and conducted weekly progress meetings.

Awards/Client Commendations:
Shaw was commended by the Army upon completion of the MEC EE/CA. The following quote is from a portion of the December 1998 letter from Stanislaw P. Gembicki, Jr., P.E., Chief, Engineering Division, USACE, Baltimore District: "This complex and sensitive task was completed by your firm both under budget and ahead of schedule because of your successful application of innovative geophysical technology combined with the development of a new quality control process; the implementation of minimum evacuation distances while maintaining a high level of safety; and by aggressively managing all team members and activities to maximize work efficiency. ...the calculated savings to the government from your efforts is over $848,000."

12/1996 - 05/2002
Geologist, IT Corporation, Edgewood, Maryland

Responsibilities include providing support to client projects and office staff as a technical consultant. Also responsible for business development, preparing technical reports and proposals. Recent assignments have included:

The following is a summary of key projects:
Quality Control, Site Assessment, VDOT, Frederick Area Headquarters, Virginia Department of Transportation, Frederick Area Headquarters, Suffolk, Virginia, 04/1999 - 09/1999
Performed quality control oversight during environmental sampling on VDOT property and right-of-ways located on a site proposed for inclusion on the National Priorities List (NPL). The site is a former ordnance depot with UXO and OE contamination concerns. Reviewed work plans and provided on-site inspection of field activities and compliance with work plans, OE avoidance plans, and USEPA Environmental Response Team (ERT) standard operating procedures. Field activities included soil, sediment, surface water and groundwater sampling as well as monitoring well installation and development.

Geologist, Feasibility Study, Former Skeet Range, Fort Ritchie, 866708, U.S. Army Corps of Engineers, Baltimore District,, Fort Ritchie, Maryland, 06/1997 - 06/1998
Developed and wrote a feasibility study for a site contaminated with lead shot. Summarized data from previous studies, established remedial action objectives, identified and screened remedial technologies, and developed and evaluated remedial alternatives. Evaluated and compared remedial alternatives according to NCP criteria.

04/1996 - 12/1996
Project Manager, Louis Berger & Associates, Inc., Gaithersburg, Maryland

Responsibilities include directing project tasks to maintain cost and schedule requirements. Also responsible for business development, staffing, and proposals.
Assignments included:

The following is a summary of key projects:
Project Manager, Site Investigation, Multi-Sites, Fort Riley, U.S. Army Corps of Engineers, Kansas City District, Fort Riley, Kansas, 04/2006 - 12/2006
As Project Manager, oversaw the investigation of sites requiring additional study including electrical substations, a lead contaminated incinerator/landfill, and an open burn/open detonation area (OB/OD). Developed work plans, coordinated with client and subcontractors, maintained schedules, and developed cost proposals.

03/1994 - 12/1996
Geologist, Louis Berger & Associates, Inc., Gaithersburg, Maryland

Responsibilities include providing support to client projects and office staff as a technical consultant. Also responsible for business development, preparing technical reports and proposals. Assignments included:

The following is a summary of key projects:

Geologist, Site Assessment, Denver Federal Center, Denver Federal Center, Denver, Colorado, 09/1995 - 12/1996

As Project Geologist, performed various field activities in support of environmental site characterization of a former munitions plant to be used for the proposed USGS National Water Quality Laboratory. Assisted in the preparation of technical procedures for quality assurance project plans. Performed geologic borehole logging, oversaw monitoring well construction, developed and sampled groundwater monitoring wells.

Geologist, Marshall Army Air Field - Former Fire Training Area, U.S. Army Corps of Engineers, Kansas City District, Fort Riley, Kansas, 05/1994 - 12/1996

As Project Geologist, performed field activities related to characterization of a site contaminated by chlorinated solvents and petroleum hydrocarbons. Performed geologic logging and oversaw monitoring well installations at multiple depths to characterize the horizontal and vertical extent of groundwater contamination. Logged over 50 soil borings with concurrent soil sampling. Managed investigation-derived waste (IDW), installed piezometers, installed dedicated bladder pumps, sampled groundwater, and assisted in the planning and data analysis of a seismic reflection geophysical survey. Performed vapor sampling at wellheads and vapor probes associated with soil vapor extraction and bioventing systems. Assisted in writing the Site Investigation Report, produced data summary reports, created geologic cross sections and contour maps using CADD, and managed a GIS database. Communicated with client, USACE Technical Managers, Contracting Officer Representative (COR), and regulators.

Geologist, Remedial Investigation and Pilot Study, Dry Cleaning Facility, Fort Riley, U.S. Army Corps of Engineers, Kansas City District, Fort Riley, Kansas, 05/1994 - 12/1996

As Project Geologist, performed periodic groundwater sampling and monthly groundwater level measurements to investigate the extent of PCE contamination. Performed oversight during installation of water extraction and vapor extraction wells for a pilot study assessing the viability of PCE contaminated soil and groundwater remediation. Monitored wells during pumping tests. Installed/maintained groundwater data loggers to monitor water levels in multiple aquifers. Evaluated contaminant concentrations and water levels and presented the data in quarterly reports.

Geologist, Nike Missile Sites Investigation, Philadelphia, Pennsylvania, U.S. Army Corps of Engineers, Philadelphia, Pennsylvania, 03/1995 - 08/1995

As Project Geologist, prepared Site Safety and Health Plans and performed field operations at three abandoned NIKE Missile Sites. Work included: identifying the existence of abandoned underground storage tanks (USTs) using geophysical techniques, accessing and sampling the contents of sealed abandoned missile silos; and excavating and sampling the contents of USTs.

Geologist, Preliminary Assessment/Site Investigation, Pope AFB, U.S. Army Corps of Engineers, Pope AFB, North Carolina, 04/1994 - 08/1995

As Project Geologist, performed field activities and assisted in the development and writing of a PA/SI report covering 66 areas of concern. Field activities included drilling oversight/geologic logging/soil sampling of over 150 boreholes, geophysical surveys, and soil gas surveys.

Last Updated: 22 Aug 2013

Emily J. Tucker

Education

Bachelor of Science, Environmental Biology, State University of New York College of Environmental Science and Forestry, Syracuse, New York, 2009

Additional Training/Continuing Education

XRF Operator and Safety Training, Shaw , 2011
Standard First Aide with CPR/AED, American Red Cross, Baltimore, MD, 2010
OSHA Hazwoper 40hr Training, Aerosol Monitoring & Analysis, Inc., Hanover, MD, 2010
SCUBA School International Open Water Diver, National Aquatic, Syracuse, NY, 2008

Experience and Background

08/2010 - present
Scientist II, Shaw Environmental & Infrastructure, Inc., Belcamp, Maryland

Experience in task management and reporting. Task manager for two RCRA Facility Investigations sites at Redstone Arsenal where work included site walks, scoping presentation to regulators, work plan preparation, oversight of subcontractor procurement and field work. Worked as part of the technical team on multiple sites for Remedial Investigations/ RCRA Facility Investigations where work included site walks, work plan preparation, field work, and reporting (JBMDL, Ft Belvoir, and Radford AAP). Worked on technical teams for proposal preparation where work includes organizing historical site information and developing scopes of work.

Experience with data evaluation and using EXCEL and Visual Basic to create and update data organization EXCEL files. Work includes creating readable data tables for reporting chemical detections and exceedances of screening criteria used in reporting (Radford AAP, IOWA AAP, JBMDL). These skills have been used to organize and catalog data from various handheld field instruments (GPS units, XRF units, field tablets) into concise tables and forms. (Radford AAP, IOWA AAP, New Boston AFS). Additional EXCEL and Visual Basic experience in creating and organizing document archives into usable, searchable EXCEL worksheets. These document archives have been for business development and positioning for proposals.

Experience with a wide range of environmental sampling (biological, water, soil) and field work oversight as a CB&I certified Site Safety Officer. Responsible for sample collection, documentation, and results reporting. Works closely with mapping controls personnel to collect and report GPS data. Shaw certified XRF operator with experience conducting in situ and ex situ XRF analysis at various sites; including Fort Belvoir and Radford Army Ammunition Plant.

05/2010 - 08/2010
Field Technician- Fisheries Biologist, New York State Department of Environmental Conservation, Cape Vincent, New York

Conducted Creel Survey, adhering to survey protocol for long term monitoring. Surveyed fishing boats and collected biological data from fish specimens.

Last Updated: 26 Feb 2012

David P. Coe

Professional Qualifications
Mr. Coe is an Unexploded Ordnance (UXO) Senior Supervisor with 24 years of experience. He is familiar in the identification of foreign and domestic military ordnance. He has acted with the capacity of Senior Supervisor, Team Leader, Safety and Quality Control on UXO projects.

Education
Associate of Arts, Liberal Arts, University of Maryland, Need city, Maryland, 1984

Additional Training/Continuing Education
USACE Construction Quality Management for Contractors, West Palm Beach, FL, 2008
Competent Person Course, 2003
UXO Supervisor Course, 2002
40-Hour OSHA Training, 1991
US Navy Explosive Ordnance Disposal Course (Phases I, II and III), 1979

Experience and Background

11/2002 - Present
UXO Senior Supervisor/Team Leader, Shaw Environmental & Infrastructure, Inc., Monroeville, Pennsylvania

Responsibilities include supervising and participating in the locating, identification and disposal of hazardous military ordnance. Completing all required documentation and coordinating with other site agencies.

The following is a summary of key projects:
Senior UXO Supervisor and Safety Officer, Kissimmee River Restoration, U.S. Army Corps of Engineers, Avon Park, Florida, 09/2005 - Present
Supervised six UXO Technicians while supporting a Prime and four other Subcontractors during the realignment of the Kissimmee River. Provided UXO Briefings to over 40 employees while working on the former and current Avon Park Air Force Base Bombing Range. Completed and forwarded Field Activity Daily Logs, Tailgate Safety Meetings and Job Safety Analysis to Shaw Project Manager and both Omaha and Jacksonville Corp of Engineers. Completed weekly work schedules to ensure all contractors were provided UXO Support.

UXO Team Leader, Ft. Ritchie, U.S. Army Corps of Engineers, Cascade, Maryland, 04/2005 - 09/2005
Supervised a five man team in a subsurface search of military ordnance. Items were located using magnetometers, excavated and disposed of if hazardous. All required documentation, i.e. Dig Permits, JSA's, Anomaly Identification Sheets, Explosive Logs, and Field Activity Daily Logs were completed.

UXO Senior Supervisor/Team Leader, Avon Park Bombing and Gunnery Range, U.S. Army Corps of Engineers, Avon Park, Florida, 12/2004 - 03/2005
Provided ordnance avoidance during surveying and well drilling operations. Managed four, two man teams during surveying of the Kissimmee River Project. Operator of water craft during project. Completed required float plans and Field Activity Daily Logs and approved expense reports and time sheets for all personnel.

UXO Senior Supervisor, Patuxent NAS and Webster Field Remediation, Department of the Navy, Lexington Park, Maryland, 05/2004 - 11/2004
Provided construction support during the excavation of areas containing unexploded ordnance. Recovered 3 and 5 inch navy projectiles in addition to 100, 500 and 750 pound general purpose bombs. First Shaw UXO team to use the remote drill to determine filler of items encountered. Attended base meetings and interacted with all base agencies during this project.

UXO Supervisor, Ft. Ord, U.S. Army Corps of Engineers, Monterey, California, 10/2003 - 01/2004
Supervised a 15 man team during a surface clearance of a rocket and grenade range. Supervised explosive demolition of all hazardous items encountered. Completed required documentation.

UXO Team Member/Team Leader, Camp Hale, U.S. Army Corps of Engineers, Leadville, Colorado, 06/2003 - 09/2003
Member of a 15 man team during a surface clearance. Located, identified and explosively disposed of all hazardous items encountered. Performed duties as Team Leader as required. Completed required documentation.

UXO Team Member, Yorktown NAS, Department of the Navy, Newport News, Virginia, 11/2002 - 05/2003
Provided construction support during excavation of contaminated areas. No ordnance was recovered during this phase.

06/1969 - 11/1991
Master Sergeant, US Air Force, Various, Maryland

United Stated Air Force, Retired Master Sergeant with 23 years of service. Duties included EOD Team Leader, Safety/Quality Assurance and Shop Superintendent. Provided assistance to local police departments and the Secret Service in support of the President of the United States.

WILLIAM P. DICKSON

DATE ATTENDED BASIC EOD SCHOOL: DEC 1977 – APR 1978

OTHER PERTINENT TRAINING: OSHA 40 HOUR HAZWOPER; OSHA 8 HOUR REFRESHER AND SUPERVISOR; USACE CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS; OSHA 30 HOUR CONSTRUCTION SAFETY; SITE SAFETY OFFICER

MILITARY EOD ASSIGNMENTS:

APR 78 – OCT 79	50th ORD DET (EOD), Granite City, IL. Explosive Ordnance, Disposal Team Member. Unit Supply NCO. Participated in range clearance at Ft. Leonardwood, MO.
OCT 79 – AUG 82	2nd ORD DET (EOD), Graffenwoehr, Germany. Explosive Ordnance Disposal Team Member. Participated in range clearance operation at Hohenfels and Graffenwoehr.
AUG 82 – MAR 84	EOD Training Detachment #1, Indian Head, MD. EOD instructor at Demolition Range.
APR 84 – SEP 84	EOD Training Detachment #1, Indian Head, MD. EOD instructor at CORE Division. Primary instructor for EOD fundamentals section CORE Division.
OCT 84 – JUL 87	EOD Training Detachment #1, USAMMCS, Redstone Arsenal, AL, W/duty at Indian Head, MD (NAVSCHOLEOD). Senior instructor/course writer assigned to curriculum development.
AUG 87 – DEC 88	549th Ordnance Detachment (EODCT), Fort Meade, MD. Operations Supervisor, responsible for the assignment of all U.S. Secret Service and State Department EOD support missions involving Department of Defense EOD assets.
JAN 89 – MAY 91	57th Ordnance Detachment (EOD), Fort Belvoir, VA. Senior Supervisor for detachment consisting of 13 personnel.
JUN 91 – AUG 92	144th Ordnance Detachment (EOD), Fort Meade, MD. Senior Supervisor/Acting Commander for detachment, directly Responsible for 10 personnel and over $1,000,000 in property and equipment.
AUG 92 – MAR 94	15th Ordnance Battalion, Muster, Germany. Administration Supervisor responsible for training program, school management, physical and personnel security and ammunition operations of a European based conventional ammunition battalion consisting of 900 U.S. and 700 German civilian personnel.

CIVILIAN UXO EXPENIENCE:

SEP 94 – FEB 98	UXB International, Inc. Ashburn, VA. UXO Tech II at Twin Cities AAP, MN. UXO Tech II at Morgan Depot, NJ. UXO Supervisor completing surface clearance Operations at Longhorn Army Ammo Plant, TX. UXO Supervisor of three five man teams completing 250 acre range clearance at Fort Windgate, NM. Ordnance. UXO Supervisor for OEW sampling at Fort Meade, MD. UXO Supervisor for Ordnance clearance of a WWII gunnery range at Tullahoma, TN. UXO Supervisor for surface clearance at Fort Bliss, TX. UXO Tech II at Kaho'olawe Island, HI. UXO Supervisor for hazards and landmine contamination and demining, for USAID and Parsons in Bosnia-Herzegovina. UXO Tech II surface and subsurface clearance at Camp Stanley, TX. UXO Tech II surface clearance at Buckley Field, CO.
MAR 98 – APR 00	Computer Sciences Corporation – Systems Engineering Division, Dahlgren, VA – Engineer.
MAY 00 – JUN 00	EODT – Hohenfels, Germany. UXO Tech II, Tank range surface and subsurface clearance.
JUN 00 – JUL 00	EHSI – Duck, NC. UXO Tech II, Range clearance at WWII Navy bombing range.
AUG 00 – SEP 00	USA – Fort McClellan, AL. UXO Tech II, surface and subsurface clearance.
OCT 00 – JUL 01	USA – Conway BGR, SC. UXO Tech III Supervisor, Cont. Support.
JUL 01 – OCT 01	ADVENT – Fort Ritchie, MD. UXO Tech II, surface and subsurface clearance.
OCT 01 – NOV 01	IT CORP. – Washington D. C. UXO Tech II, Anthrax Cleanup at the U.S. Captial.
NOV 01 – DEC 01	IT CORP. – Fort Ritchie, MD. UXO Tech III Supervisor, surface and subsurface clearance.
MAR 02 – JUL 02	IT CORP. – Fort Ritchie, MD. UXO Tech II, surface and subsurface clearance.
JUL 02 - DEC 02	Shaw Environmental & Infrastructure, Inc., - Dahlgren, VA. UXO Tech III Supervisor, Remedial design of Site 46 Landfill A, Stump Dump Road, Excavation and off-site disposal of waste.

FEB 03 - Jan 04	Foster Wheeler Environmental - Dahlgren, VA. UXO Tech III - Remedial design of site 6 Landfill/wetland. Removal of all contaminated material, Restore site back to a wetland.
FEB 04 - OCT 06	Tetra Tech - Rocky Mountain Arsenal (RMA) Denver, CO. UXO Tech III, Surface and subsurface MEC/MPPEH clearance of 7 Sites.
DEC 06 - JAN 07	Tetra Tech - Edison New Jersey. UXO Tech III, Digital Geophysical Assessment – Digital Geophysical Assessment of Area 12 at the Former Raritan Arsenal.
MAR 07 - JUN 07	Tetra Tech - Naval Air Station, Alameda, CA. UXOSO/QC - Recovery, Processing, and Disposition of recovered Munitions and Explosives of Concern/Material Potentially Presenting an Explosive Hazard (MEC/MPPEH) in support of the Time-Critical removal Action (TCRA) at Installation restoration (IR) Site 1, on the former Naval Air Station (NAS) Alameda Point.
JUL 07 - SEP 07	Tetra Tech - Fort Sill, Oklahoma. UXO Tech III - MEC/MPPEH clearance of former grenade and rocket ranges.
SEP 07 - DEC 07	Tetra Tech - Fort Bragg, North Carolina. UXO Tech III - MEC/MPPEH range clearance of ranges 69 & 70.
MAY 08 - OCT 08	Tetra Tech - Martha's Vineyard/Noman's Island, MA. UXO Tech III - MEC/MPPEH Range Clearance of whole island.
DEC 08 - FEB 09	Tetra Tech - Elgin Air Force Base, Elgin, FL. UXO Tech III - Surface/MEC clearance of 500 Acres Cantonment Area & 89 Acres for a road.
MAR 09 - SEP 09	Shaw E&I - Marine Corps Base, Quantico, VA. UXO Tech III - MEC/MPPEH Surface Range Clearance of Quantico's ranges.
OCT 09 - OCT 09	Shaw E&I - Ravenna Army Ammunition Plant, Ravenna, OH. UXO Tech III - Surface/Grubbing Clearance.
NOV 09 - DEC 09	Shaw E&I - Marine Corps Base, Quantico, VA. UXO Tech III - MEC/MPPEH Surface Range Clearance of Quantico's ranges.
JAN 10 - MAR 10	Shaw E&I - Spring Valley Formerly Used Defense Site, USACE, Spring Valley, Washington, D.C. NW. SUXSO - Anomaly Investigation for Military Munitions Response Program.
APR 10 - MAY 10	Shaw E&I - Marine Corps Base, Quantico, VA. UXO Tech III - MEC/MPPEH Surface Range Clearance of Quantico's ranges.

MAY 10 - MAY 10	Shaw E&I - Spring Valley Formerly Used Defense Site, USACE, Spring Valley, Washington, D.C. NW. SUXSO - Anomaly Investigation for Military Munitions Response Program.
JUN 10 - JUL 10	Shaw E&I - Marine Corps Base, Quantico, VA. UXO Tech III - MEC/MPPEH Surface Range Clearance of Quantico's ranges.
JUL 10 - SEP 10	Shaw E&I - Webster Field PAX River, Maryland. SUXOS - MEC/MPPEH Anomaly Investigation.
OCT 10 - DEC 10	Shaw E&I - Marine Corps Base, Quantico, VA. UXO Tech III - MEC/MPPEH Surface Range Clearance of Quantico's ranges.
JAN 11 - FEB 11	Shaw E&I - Spring Valley Formerly Used Defense Site, USACE, Spring Valley, Washington, D.C. NW. SUXSO - Anomaly Investigation for Military Munitions Response Program.
FEB 11 - FEB 11	Shaw E&I - Indian Head, Maryland. UXO Tech III - Indian Head Scrap Yard. Investigation for MEC & Ship MPPEH.
FEB 11 - APR 11	Shaw E&I - Marine Corps Base, Quantico, VA. UXO Tech III - MEC/MPPEH Surface Range Clearance of Quantico's ranges.
APR 11 - MAY 11	Shaw E&I - Spring Valley Formerly Used Defense Site, USACE, Spring Valley, Washington, D.C. NW. SUXSO - Anomaly Investigation for Military Munitions Response Program.
MAY 11 - AUG 12	Shaw E&I - Marine Corps Base, Quantico, VA. UXO Tech III - MEC/MPPEH Surface Range Clearance of Quantico's ranges.
NOV 12 - FEB 13	Shaw E&I - New York City, NY. NYC Rapid Recover Repair, Breezy Point, NY. QC/QA Monitoring Contractor Navillus while installing Water Heaters, Boilers, & Electric to over 2500 homes in Breezy Point & Gerritsen Beach, New York City for Sandy Relief.
MAR 13 - APR 13	BC&I/Shaw E&I - St. Julines Creek Annex, Chesapeake, VA. UXO Tech III - Construction Support.

Last Updated: 18 Mar 2013

Jeremy L. Flemmer

Professional Qualifications

Jeremy Flemmer is a registered professional geophysicist in the state of California and has over sixteen years of experience designing, conducting, and supervising geophysical site investigations at commercial, DoD, and DoE sites. Most recently he has the been the quality control geophysicist supporting MEC removal actions at large USACE projects including Former Fort Ord, and Vandenberg Air Force Base, CA. Jeremy has also worked as a Senior Geophysicist supporting various Munitions Response task orders at Former Fort Ord, Vandenberg Air Force Base, Former Lowry Bombing and Gunnery Range, Former Conway Bombing Range, Former Crows Landing, Former Camp Robinson, Kirtland AFB, Redstone Arsenal, and Dugway Proving Ground. Additional geophysical assignments have included acquisition, interpretation, and presentation of seismic reflection/refraction, gravity, magnetic, electromagnetic, resistivity and ground penetrating radar data sets in support of ordnance and explosive (OE/UXO), utility, underground storage tank (UST), fault, hydrothermal, groundwater, petroleum, mineral, landfill, and radioactive waste surveys.

Education

Bachelor of Science, Geological Sciences, University of California at Santa Barbara, Santa Barbara, California, 1996
Master of Science, Geology/Geophysics (in progress, coursework, thesis presentation and defense complete), University of California at Davis, Davis, California

Additional Training/Continuing Education

40-Hour Hazardous Waste Operations and Emergency R, IT Corporation, 2001

Registrations/Certifications/Licenses

Registered Professional Geophysicist, 2007, 1063, Active, California, 05/2013
Radiological Worker Level II, 2002, 190499, Inactive, Nationwide, 07/2004

Experience and Background

05/2002 - Present
Senior Geophysicist, Shaw Environmental & Infrastructure, Inc., Science & Technology, Sacramento, California

Responsibilities include project planning, data acquisition, presentation, report writing, employee supervision, and client interaction. Environmental geophysics projects primarily include OE location and shallow subsurface geological and geophysical investigations.

The following is a summary of key projects:

<u>QC Geophysicist, Munitions and Explosives of Concern Remedial Action, Former Fort Ord, 846075/141234, Army Corps of Engineers, Monterey, California, 04/2006 - Present</u>
OE detection, reacquisition, and removal at multiple large sites totaling almost 2,000 acres at Former Fort Ord, Monterey California. Work was/is performed with man portable systems and an array of EM61-MK2's towed behind a tractor/bulldozer monitored by remote and local computers within the vehicle. Implemented and tested wireless, remote data acquisition systems and subsequently performed QC duties after initiation of fieldwork. This consisted of enforcing quality control parameters according to the UCACE DIDs on raw and processed geophysical data and targets, weekly reporting of site activities, on site spot checks, regular QC visits, blind seeding and interacting with USACE QA.

<u>QC Geophysicist, Military Munitions Response Action, Vandenberg Air Force Base, 123553, USACE, Vandenberg AFB, CA, 04/2011 - 10/2011</u>
DGM data was collected in support of a remedial investigation with OE removal at Vandenberg Air Force Base. Work was performed with multiple crews of man portable EM61's. Subsets of targets were picked and dug with standards developed in cooperation with USACE and Shaw. Performed quality control checks on all data, data metrics, targets, and field activities and reported results to USACE.

<u>Project Geophysicist, Point Loma Subsurface Geophysical Investigation, Defense Energy Support Center, Point Loma Naval Base, San Diego, California, 12/2009 - 02/2010</u>
A geophysical survey was performed at the Defense Fuel Support Point at Point Loma Naval Base to obtain information about the subsurface geologic features that may affect groundwater and fuel migration and plume delineation. Responsibilities included project planning and execution, seismic data collection, processing and reporting.

<u>Site Geophysicist, Multi-Channel Analysis of Surface Waves (MASW) Seismic Survey, Contracted to GEI Consultants, Marysville, California, 08/2009 - 09/2009</u>
Seismic multi-channel analysis of surface waves was conducted just east of an existing levee along the Feather River and was surveyed in order to determine the potential for this area to become a new setback levee. It was necessary to assess the subsurface conditions for potential low velocity zones that may represent weaker foundation zones and require special design considerations for the integrity of the new setback levee. Project planning, oversight of field crews, processing and client and landowner interaction were performed.

<u>Processing Geophysicist, Fort Sill Remedial Investigation Geophysical Survey, USACE, Fort Sill, Oklahoma, 04/2009 - 06/2009</u>
A full coverage geophysical survey was performed at a 25-acre project site along with soil sampling for munitions constituents (MC) and intrusive investigation for the 200 targets deemed most likely to be MEC. Responsibilities included data QC checks, processing, target picking and interaction with USACE QA regarding all results.

<u>Project Geophysicist, Reconnaissance Geophysical Investigations for the Assessment of Levee Conditions, 122238, MBK Engineers, Canal Ranch Levee, Sacramento River Delta, California, 07/2006 - 02/2008</u>
The Sacramento River Delta is the second largest river delta in the United States. Most of these levees were originally constructed in the 1800's with various materials and construction techniques. Current concerns about levee stability led to the geophysical assessment of the Canal Ranch levee in order to attempt to quickly gain as much information about the internal structure of this levee as possible. Capacitive coupling electrical resistivity imaging and ground penetrating

radar methods were utilized in order to determine levee structure and stratigraphy, as well as determine any potential seepage areas or cavities created by burrowing animals. Multiple passes were conducted around a 15 mile portion of Canal Ranch levee in a three day period. These consisted of two full length profiles of the inside and outside edge of top of the levee with electrical resistivity imaging and two full length profiles of ground penetrating radar at two different frequencies. Processing and inversion techniques were applied to this data and multiple anomalous target areas were identified. Initial field excavation of ten of these anomalies identified potential dangers of areas of loose, unconsolidated sands and material within the levee, as well as buried pipes and voids that were potentially former animal burrows. Performed project planning, field data collection and crew oversight, processing, client interaction and reporting.

Other Comments:
A paper on this topic was presented at SAGEEP (Symposium on the Application of Geophysics to Engineering and Environmental Problems) in Denver in 2006 titled, 'Reconnaissance Geophysical Investigations for the Assessment of Levee Conditions at the Canal Ranch Levee, Sacramento River Delta'.

<u>Project Geophysicist, Dugway Proving Grounds, USACE, Dugway, Utah, 03/2006 - 06/2006</u>
Geophysical surveys utilizing frequency and time domain EM methods were conducted to determine the lateral extents of waste trenches containing metallic and non-metallic ordnance and decontamination debris at multiple sites within Dugway in order to aid in the design of a landfill cover system. Responsibilities included project planning, data acquisition, presentation, reporting, employee supervision, and client interaction at various sites with discrete MEC as well as various MEC and debris in trenches.

<u>Geophysicist, Former Camp Robinson, USACE, Little Rock, Arkansas, 01/2005 - 02/2006</u>
Performed geophysical field data acquisition, processing and reporting for the Prove Out, as well as processing and QA/QC for geophysical production work.

<u>QC Geophysicist, Crows Landing CTO 110 Mec Removal, US Navy, Crows Landing, Stanislaus County, California, 05/2005 - 12/2005</u>
Acted as Quality Control Geophysicist for Crows Landing CTO 110 MEC removal action. Responsibilities included overseeing field personnel, checking daily instrument calibration tests, DGM and reacquisition data.

<u>Geophysicist, Conway Former Bombing & Gunnery Range,, Under contract to Advent Environmental, Myrtle Beach, South Carolina, 02/2004 - 05/2005</u>
Performed geophysical data processing, target picking, map creation and internal oversight for data quality objectives for large-scale (1100 acre) MEC project utilizing multiple towed array EM61 systems in conjunction with robotic total station navigation in wooded areas.

<u>Geophysical Processing, design and programming, Former Lowry Bombing and Gunnery Range Munitions Removal Action, USACE, Denver, Colorado, 11/2002 - 05/2005</u>
MEC detection survey of 175-acres, and PIG (K-941 container) Discrimination Study. The study included testing several geophysical sensors over a Free-Air Platform and PIG Test Plot and several software applications for discrimination. Processed and developed technology for the successful study. Work included the design of a Free-Air Platform and testing program, as well as the design and programming of modules within the data analysis program. The study included testing several geophysical sensors over the Free-Air Platform and PIG Test Plot and several software applications for discrimination.

Project Geophysicist, Pine Bluff Arsenal, USACE, Pine Bluff, Arkansas, 11/2004 - 01/2005
Full coverage electromagnetic methods were utilized to detect possible MEC targets across two areas totaling approximately 35 acres. Tasks included field data collection, data download, reduction and processing; target location, map creation and reporting.

Site Geophysicist, Dugway Proving Ground Geophysics Surveys of HWMU42 and HWMU43, USACE, Dugway Proving Grounds, Utah, 07/2003 - 05/2004
Geophysical surveys utilizing frequency and time domain EM methods were conducted to determine the lateral extents of municipal waste trenches containing metallic and non-metallic debris in HWMU42 and HWMU43 in order to aid in the design of a landfill cover system. Responsibilities included project planning, designing and implementing towed EM systems in the field, data acquisition, presentation, reporting, employee supervision, and client interaction.

Field/Processing Geophysicist, Navy Special Fuel Oil (NSFO) Tank Farm, US Navy, Yorktown, Virginia, 05/2003 - 07/2003
Electromagnetic, magnetic, and ground penetrating radar methods were utilized in order to delineate six former buried underground storage tanks, previously used for the storage of navy special fuel oil. Tasks included field data collection, data download, reduction and processing, as well as creation of maps and reports.

Field/Processing Geophysicist, Hunters Point, US Navy, San Francisco, California, 04/2002 - 06/2003
Seismic reflection and earth resistivity methods were performed in support of locating bedrock and subsurface ground conditions. Later ground penetrating radar and electromagnetic methods were utilized in order to locate subsurface piping and features. Tasks included field data methodology, data collection, processing and reporting.

01/2001 - 05/2002
Geophysicist, IT Corporation (The Shaw Group, Inc., acquired substantially all of the operating assets of The IT Group, Inc., on May 3, 2002), Sacramento, California

Responsibilities include project planning, data acquisition, presentation, report writing, employee supervision, and client interaction. Environmental geophysics projects primarily include OE location and shallow subsurface geological and geophysical investigations.

The following is a summary of key projects:
Project Geophysicst, Kirtland AFB MEC removal, AFCEE, Albuquerque, New Mexico, 01/2002 - 03/2002
Conducted all geophysical data collection, processing and reacquisition in support of a small, 4.5 acre MEC site. Tasks included electromagnetic field data collection, daily data download, reduction and processing; target picking, and target relocation.

Field Geophysicist, Redstone Arsenal OE Geophysics Characterization, USACE, Huntsville, Alabama, 02/2001 - 04/2001
Conducted man portable cart based and hand carried systems in firing ranges and wooded areas using multi-path rejection GPS techniques. Tasks included field data collection and geophysical data download, reduction and processing.

09/1996 - 01/2001
Geophysicist, Consulting Geologist/Geophysicist, Lodi, California

Responsibilities included conducting and managing geological and geophysical special projects in support of petroleum and hard mineral exploration projects. Responsible for database management, geologic mapping, and geophysical interpretation of 2 and 3-dimensional seismic data on a computer workstation.

06/1999 - 12/2000
Teaching Assistant, University of California at Davis, Davis, California

In charge of creating and presenting lectures, labs, field exercises and tests. Teaching experience includes introductory geology lab for geology majors, solar system, and summer field courses.

09/1996 - 06/2000
Geologist, WZI, Inc., Lodi, California

Involved with environmental and geotechnical engineering projects. Duties included regulatory agency liaison, field investigations, report writing, and computer drafting.

05/1996 - 10/1997
Exploration Geologist, Nevada Goldfields, Inc., Fairbanks, Alaska

Responsibilities included conducting research in precious metal deposits in central Alaska. Duties included surface geological mapping, geochemical surveys, drill core logging, trench mapping, compilation of data, literature review, field and CAD map creation, and support of technical report presentation.

09/1995 - 05/1996
Lab Assistant/Geologist, University of California at Santa Barbara, Santa Barbara, California

Conducted mechanical and chemical separations of zircon minerals for U-Pb dating.

Appendix G

Technical Project Planning Meeting Minutes

TECHNICAL PROJECT PLANNING MEETING MINUTES
FEBURARY 26, 2014
MMRP MUNITIONS RESPONSE SERVICES FORT STEWART

Date: 2/26/14
Time: 10:00AM EST to 1:00PM EST
Place: Georgia Environmental Protection Division (EPD), Atlanta, Georgia
Attendees (see attached sign in sheet)**:**

- William Powell, Georgia EPD
- Amy Potter, Georgia EPD
- Mo Ghazi, Georgia EPD
- Ana Vergara, USACE, Savannah District
- Zsolt Haverland, USACE, Savannah District
- Maria Orosz, USACE, Baltimore District
- Tom Colozza, USACE, Baltimore District
- Debbie McKinley, USACE, Baltimore District
- Algeana Stevenson, Ft Stewart
- Paul Higgs, US Army Environmental Command
- Alex Smith, CB&I Federal Services
- Laura O'Donnell, CB&I Federal Services
- Emily Tucker, CB&I Federal Services

Introduction:

Ana Vergara, USACE project manager, and Maria Orosz, USACE technical lead, provided a brief introduction to the project. Algeana Stevenson noted that there are other MRS's at Ft. Stewart that are being addressed under a different contract. The rest of the meeting was guided by Alex Smith, following the attached Power Point presentation. The detailed information is captured on the presentation, with a summary provided below along with the content of discussion points.

Technical Project Planning (TPP) Process:

The presentation provided a brief overview of the TPP process including the four phases: 1) Identification of current project area, 2) Determination of data needs, 3) Development of data collection options, and 4) Finalization of the data collection program.

Military Munitions Response Program (MMRP):

The presentation provided a brief overview of MMRP terminology, including: Munitions and Explosives of Concern (MEC), Unexploded Ordnance (UXO), Discarded Military Munitions (DMM), Material Potentially Presenting an Explosive Hazard (MPPEH), Material Documented as Safe (MDAS), Munitions Constituents (MC), and Munitions Response Site (MRS).

Ft Stewart Military Munitions Response Program:

The presentation provided a review of the pertinent site characteristics, with additional information provided at the meeting. Most notable information regarding the site:

- Four MRS's are addressed under this contract:
  - FTSW-009-R-01: Anti-Aircraft Range 4A
  - FTSW-009-R-02: Anti-Aircraft Range 4B
  - FTSW-010-R-01: Anti-Tank Range 90-mm-2
  - FTSW-011-R-01: Grenade Launcher Range
- The majority of Ft. Stewart is comprised of operational ranges.
- Two Historical Records Reviews (2006 and 2010), and two Confirmatory Sampling Reports (2007 and 2012) have been conducted as well as EOD responses and Investigations conducted by USACE (2011)

Geophysical Survey Tools:

- The presentation provided a review of tools that can be used to characterize the nature and extent of MEC/MC including: visual surveys, geophysical surveys, statistically based sampling software, intrusive investigations, and environmental sampling
- Amy Potter expressed that Georgia EPD (GAEPD) would like to see DGM used more often as analog geophysics has a greater associated risk. GAEPD is of the opinion that analog is subject to more user

error and there is a risk of leaving items in the ground that were not identified with a Schonstedt due to their orientation in the ground. CB&I responded that a thorough QC program, including blind seeds, is incorporated with analog geophysics to ensure that the capabilities of the instrument and operator are in compliance with DQOs. GAEPD requested that these details be included in work plan text so that it can be thoroughly reviewed.

- The RFI will use a combination of analog geophysics and DGM. Analog geophysics allows anomalies to be identified and investigated in one pass, while DGM requires several passes over the same area to collect the data, reacquire the anomaly locations after the data is processed, and then intrusively investigate the anomalies. This poses difficulties with returning to the exact location when under tree canopy where GPS signals can be blocked. Repeated traversing of the same area also may have negative impacts on the wetlands.
- VSP and UXO Estimator are statistical tools used in planning the investigation and in analyzing data collected.

Anti- Aircraft Range 4A/B:

- These two MRSs are the firing points for three separate/collocated anti-aircraft ranges. The Range fans extend well beyond the MRS into the Operational Ranges of Ft. Stewart
- The CSM of the ranges is that anti-aircraft 90mm guns and 40mm guns were fired into the air at various trajectories at moving aerial targets, primarily M2 Rockets. The maximum distance of the target M2 Rockets is approximately 1 mile, which is within the MRS; suggesting that they will be found in the MRS. The typical range of the 90mm and 40mm projectiles will vary with trajectory of fire, but most commonly is expected to extend beyond the MRS into the operational range. Site use at 4A and 4B is considered the same, and distribution of MEC items in the 2 MRSs is considered homogenous because there are no fixed, land based targets where MEC/MD would cluster.
- Range 4A is 465 acres and has been largely developed. A number of EOD responses occurred during the recent development. CENAB performed MEC QA investigations and a TCRA during the construction. The current and future land use is residential and industrial including: barracks, operations facilities, and maintenance facilities
- Range 4B is 663 acres and largely undeveloped and uninvestigated. The southern portion of 4B is a non –residential portion of the cantonment area with a horse stable and a maintenance facility.
- Environmental sampling was conducted during the Phase 2 Confirmatory Sampling (2010) and metals were detected well below USEPA RSLs and region 4 Ecological Screening Values, and no explosives were detected above reporting limits. The CS recommended a RFI for MEC.
- Several investigations have been conducted at 4A. Items found include small arms, MDAS (M2 Rockets, M2 Target rocket motors, 3.5" rocket motor, 81mm Practice Motors, 20mm projectiles, M2 BAT rockets, metal frag,) and MEC (1 point detonating fuze, 1 M79 90mm HE-T)
- There was a short discussion of historical aerial photos and if there was any photographic evidence of firing points.
- Data Quality Objectives (DQOs) were reviewed for Anti-Aircraft Range 4A/B
- Anti-Aircraft Range 4A Approach was presented as follows:
  - CENAB has investigated 200 of the 465 acres, no need to collect additional data
  - UXO calculates with 95% probability that there is less than 0.017 UXO/acre using existing data.
- Anti-Aircraft Range 4B Approach was presented as follows:
  - Collect 6 acres of MEC investigation as dictated by UXO estimator. 12 miles of transects at a 325 ft spacing plus 4 grids (50'x50')
  - DGM will be conducted in open areas near potential firing points to look for buried DMM. CB&I clarified that while 4 grids will be "carved out" of the DGM data and used to add to UXO estimator acreage, the DGM investigation will not be limited to these 4 grids. The DGM investigation and the use of acreage for statistical purposes will be described work plan.
  - There was a discussion about investigating the wetlands portions of the site:
    - Amy Potter, GAEPD was concerned about avoiding wetlands with the transects, and suggested that this could lead to LUCs being implemented for the wetlands. CB&I stated that the statistical programs do not require even distribution of data across the site, and are actually based on random placement of data. With an underlying assumption of homogenous distribution, the conclusions made for the non-wetlands can be made for the wetlands also. She stated a preference for covering the entire site and would like to see as much coverage as possible in the wetlands.

        - Ft Stewart would ultimately like to see the fences surrounding the wetlands within the 4A MRS removed.
        - CB&I can perform transects in the wetlands, but the difficulty is in intrusively investigating anomalies underwater. Analog geophysics can be conducted to 3ft, but digging to investigate anomalies is difficult due to the water filling the hole. CB&I can use pumps to remove the water and/or tactile methods of identifying anomalies, as long as Fort Stewart is comfortable with digging small holes in the wetlands.
        - Algeana Stevenson will discuss with the Ft Stewart wetlands group about dry seasons/amount of standing water in the wetlands as well as if they are okay with intrusive investigations in the wetlands.
        - The project team agreed that a discussion with the Ft Stewart wetlands group is required to determine to what extent field work is allowed in wetlands areas. Based on their response, appropriate text and details will be incorporated into the work plan. If an investigation of wetlands is allowed, transects will be placed within the fenced areas. If investigation of these areas is not acceptable, transects will be moved in order to obtain the required spatial coverage. All project team members agreed with this approach.
    - CB&I also identified an 8-acre area in the southeast where a grenade had been found. The proposed approach for this area is surface sweep, as hand grenades do not penetrate into the ground.
    - With the sampling done previously for the CS, CB&I recommended that no further media sampling was necessary for MC unless there was a basis for collecting a sample (i.e., buried DMM, exposed fillers, or small arms berms).

Anti-Tank Range 90-MM-2:

- This is a 546 acre site that was used for anti-tank, anti-aircraft, grenade launcher, and small arms training during the 1940s. The MRS is the firing point of these ranges, and the range fans extend well beyond the MRS and into the operational range.
- The MRS is currently partially forested and grassland and comprised partly of the non residential cantonment area, including a motor pool, fueling station, and borrow area.
- Previous investigations include the Phase 2 Confirmatory Sampling Report. A magnetometer assisted visual survey was conducted through undeveloped portions of the MRS. One MDAS item was found on the surface. MC sampling was conducted and some metal were detected, but below screening levels and no explosives were detected. The Phase 2 Confirmatory Report recommended a RFI for MEC.
- DQOs were reviewed for Anti-Tank Range 90-MM-2.
- The following approach was presented:
    - Collect 6 acres of data based on UXO Estimator with 95% confidence that there are less than 0.5 UXO/acre. This will include 2.6 miles of transects at 272 ft spacing.
    - Additional geophysics (DGM) will be conducted at potential former firing points looking for DMM disposal pits.
    - Will Powell, GAEPD, was interested in where the impact area was within the range fans shown. CB&I stated that some of the targets were moving targets in the area now covered by the landfill. Some of the targets were aerial with fired artillery expected to leave the MRS and enter the operational range area. Due to the concern over targets to be located in and around the landfill, CB&I ran Visual Sample Plan (VSP) "Find Target Areas" mode to determine the appropriate spacing required to traverse and detect a 90mm HE target. The VSP spacing and UXO Estimator spacing were compared and the UXO Estimator spacing was more conservative (i.e., tighter line spacing). Additionally, CB&I does not expect to find target areas within the MRS. As such, UXO Estimator-based transects were selected. All project team members agreed with this approach. With the sampling done previously for the CS, CB&I recommended that no further media sampling for MC was necessary unless there was a basis for collecting a sample (i.e., buried DMM, exposed fillers, or small arms berms).

Grenade Launcher Range:

- This is a 143 acre site where there are several former ranges: Small Arms Ranges H,B, and A, Range B was also used for 40mm practice grenades, and Range H was also used as an infiltration course. Additionally, part of the firing point for a 120mm projectile is included within the MRS.
- The former site use was described. The berms did not include the targets; rather the targets were raised and lowered from behind the berms. The former use of the infiltration course at Range H was also

described. Soldiers would have to navigate a course where 0.30-cal machine guns were fired and TNT was detonated to simulate battle conditions.

- Previous investigations include the Phase 2 Confirmatory Sampling Report. A magnetometer assisted visual survey was conducted over 10% of the undeveloped area (approximately 4 acres). Pop flares (expended). Empty ammo cans, and expended small arms cartridges were observed. MC sampling was conducted. Lead was detected at a maximum concentration of 61.4 mg/kg. No other metals were detected above screening levels, and no explosives were detected. A RFI for MEC was recommended.
- DQOs were reviewed for the Grenade Launcher Range.
- The following approach was presented:
    - Concentrated areas of MEC/MDAS may be present in/around the Range B target berm where the grenade launchers were fired. Individual targets are assumed to be 10 meters in diameter based on historical range construction guidance. VSP was used to place transects to identify any concentrated areas with a 10 meter diameter target input.
    - 4-ft wide mag and dig transects will be conducted around the target berm to determine if UXO are present.
    - DGM will be conducted around the 120mm Range firing points.
    - Will Powell, GAEPD raised questions if the grenade targets were at the target berm or an area within the range (i.e., to the southeast of the target berm). CB&I answered that the target berm was the logical place for targets, but would review available information to verify. Most of the range has been recently developed with no records of anything found or any EOD calls, so there is a line of evidence that suggest that UXO are not present in the developed areas. GAEPD agreed with this response but requested that aerial photos be reviewed.
    - With the sampling done previously for the CS, CB&I recommended that no further media sampling for MC was necessary unless there was a basis for collecting a sample (i.e., buried DMM or exposed fillers).

Anticipated Schedule:

- Technical Project Planning Meeting – February 26, 2014
- RFI Work Plan
    - Draft to Army – March 2014
    - Draft Final to GAEPD – May 2014
    - TPP #2 – June 2014
    - Final – September 2014
- Field Effort- September- December 2014
- RFI Report
    - Draft to Army – January 2015
    - Draft Final to GAEPD – March 2015
    - TPP #3- May 2015
    - Final – July 2015
- There's interest in pushing the schedule forward if documents can get reviewed in an expedited fashion, such that the field work can be done in the summer when it is drier. This will allow the wetlands to be more thoroughly investigated.

Follow-up Items:

- Algeana Stevenson to speak with the Ft Stewart wetlands group about investigating the wetlands areas.
- CB&I will review historical aerial photos of the ranges to ensure that target areas and firing points are understood, especially at the Grenade Launcher Range.
- CB&I will develop a work plan incorporating the information presented and results of discussions.

Attached: Sign-in Sheet, TPP Presentation

February 26, 2014
10:00 AM
EPD Conference Room 1054

Sign-In Sheet

Fort Stewart MMRP TPP #1 Meeting
Atlanta, GA

Name	Position	Organization	Phone#	E-mail address
WILLIAM POWELL	Environmental Engineer	DNR-EPD	404-657-8680	william.powell@dnr.state.ga.us
AMY POTTER Amp	Unit Coordinator	DNR-EPD	404-657-8604	amy.potter@dnr.state.ga.us
MO GHAZI AMG	Geologist	DNR-EPD	404-657-8668	mo.ghazi@dnr.state.ga.us
Ana Vergara	Project Manager	COE-SAS	912-652-5835	ana.vergara@usarmy.mil
Laura O'Donnell	Engineer	CB&I	410-273-7242	laura.odonnell@cbifederalservices.com
Emily Tucker	Scientist	CB&I	410-273-7330	emily.tucker@cbifederalservices.com
DEBBIE McKINLEY	ENV ENG	USACE	410-962-6738	DEBORAH.K.McKINLEY@USACE.ARMY.MIL
ALEX SMITH	PROJECT MGR	CB&I	240-586-1341	ALEXANDER.SMITH@CBIFEDERALSERVICES.COM
Paul Higgs	ENV. MGT	AEC	210-466-1727	paul.a.higgs@us.army.mil
Algeana Stevenson	Chem. Eng.	FS/HAAF	9123155144	algeana.l.stevenson.civ@mail.mil
Maria Orosz	Tech Lead	USACE	410-962-2700	maria.t.orosz@usace.army.mil
Tom Colozza	GEOPHYSICS	USACE	410-962-6647	Thomas.s.colozza@usace.army.mil
ZSOLT HAVERLAND	GEOLOGIST	USACE-SAV	912-652-5815	ZSOLT.E.HAVERLAND@USACE.ARMY.MIL
Mo Ghazi	Geologist	GA-EPD		

MMRP Munitions Response Services
Fort Stewart
TPP Meeting 1

February 2014

US Army Corps of Engineers
BUILDING STRONG®

Agenda

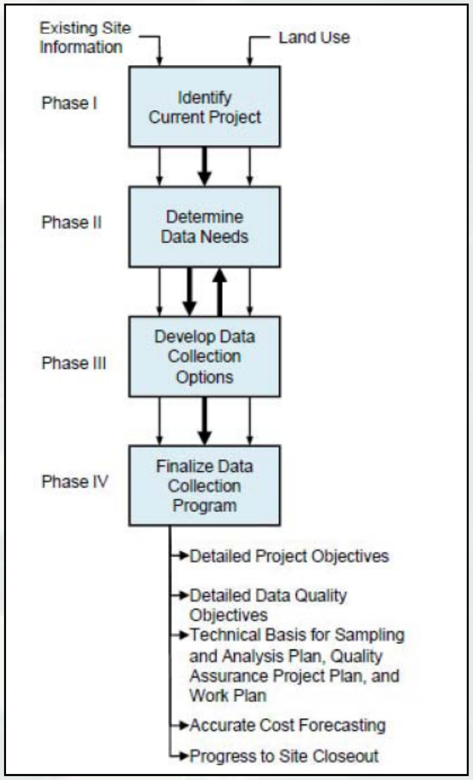
- Introductions, Overview
- Fort Stewart MMRP
- Munitions Response Site (MRS) Review
    - FTSW-009-R-01: Anti-Aircraft Range 4A;
    - FTSW-009-R-02: Anti-Aircraft Range 4B;
    - FTSW-010-R-01: Anti-Tank Range 90-MM-2; and
    - FTSW-011-R-01: Grenade Launcher Range
  - ► Review of Background Information
  - ► Development of CSM, DQOs, and Approach
- RFI Deliverables and Schedule

Introductions

- Fort Stewart
  - Algeana Stevenson
- U.S. Army Environmental Command
  - Paul Higgs
- U.S. Army Corp of Engineers, Savannah District
  - Ana del Vergara, Project Manager
- U.S. Army Corp of Engineers, Baltimore District
  - Maria Orosz, Technical Lead
  - Tom Colozza, Geophysicist
  - Deborah McKinley, Engineer
- Georgia Environmental Protection Division
- CB&I
  - Alex Smith, Project Manager
  - Laura O’Donnell, Technical Support
  - Emily Tucker, Technical Support

Technical Project Planning (TPP) Process

- TPP Process consists of four phases:
  - Phase I – Identify Current Munitions Response Site Project
  - Phase II – Determine Data Needs
  - Phase III – Develop Data Collection Options
  - Phase IV – Finalize Data Collection Program
- TPP Meeting 1 covers Phases I-IV.
- TPP Meeting 2 will finalize the work plan, if needed.
- TPP Meeting 3 will discuss the Draft Final Report.



Terminology

RCRA Terminology

- Resource Conservation and Recovery Act (RCRA)
  - Enacted in 1976, RCRA promotes the protection of health and the environment. It regulates waste generation, treatment, storage, transportation, and disposal for facilities currently in operation.
- RCRA Facility Investigation (RFI)
  - The purpose of an RFI is to determine the nature and extent of releases of hazardous wastes or hazardous constituents from regulated units, solid waste management units, and other source areas at the facility, and to gather all necessary data to support a Corrective Measures Study.
  - Parallels the CERCLA Remedial Investigation

MMRP Terminology

- Military Munitions Response Program (MMRP)
  - Directs environmental cleanup at locations where MEC and MC are known or suspected to be present
- Munitions and Explosives of Concern (MEC)
  - Distinguishes specific categories of military munitions that may pose unique explosives safety risks means:
    - Unexploded ordnance (UXO), as defined in 10 U.S.C. 101(e)(5) as Military munitions that (A) have been primed, fuzed, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (C) remain unexploded either by malfunction, design, or any other cause.
    - Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2): Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal.
    - Munitions constituents (e.g., TNT, RDX), as defined in 10 U.S.C. 2710(e)(3), present in high enough enough concentrations to pose an explosive hazard

MMRP Terminology (cont.)

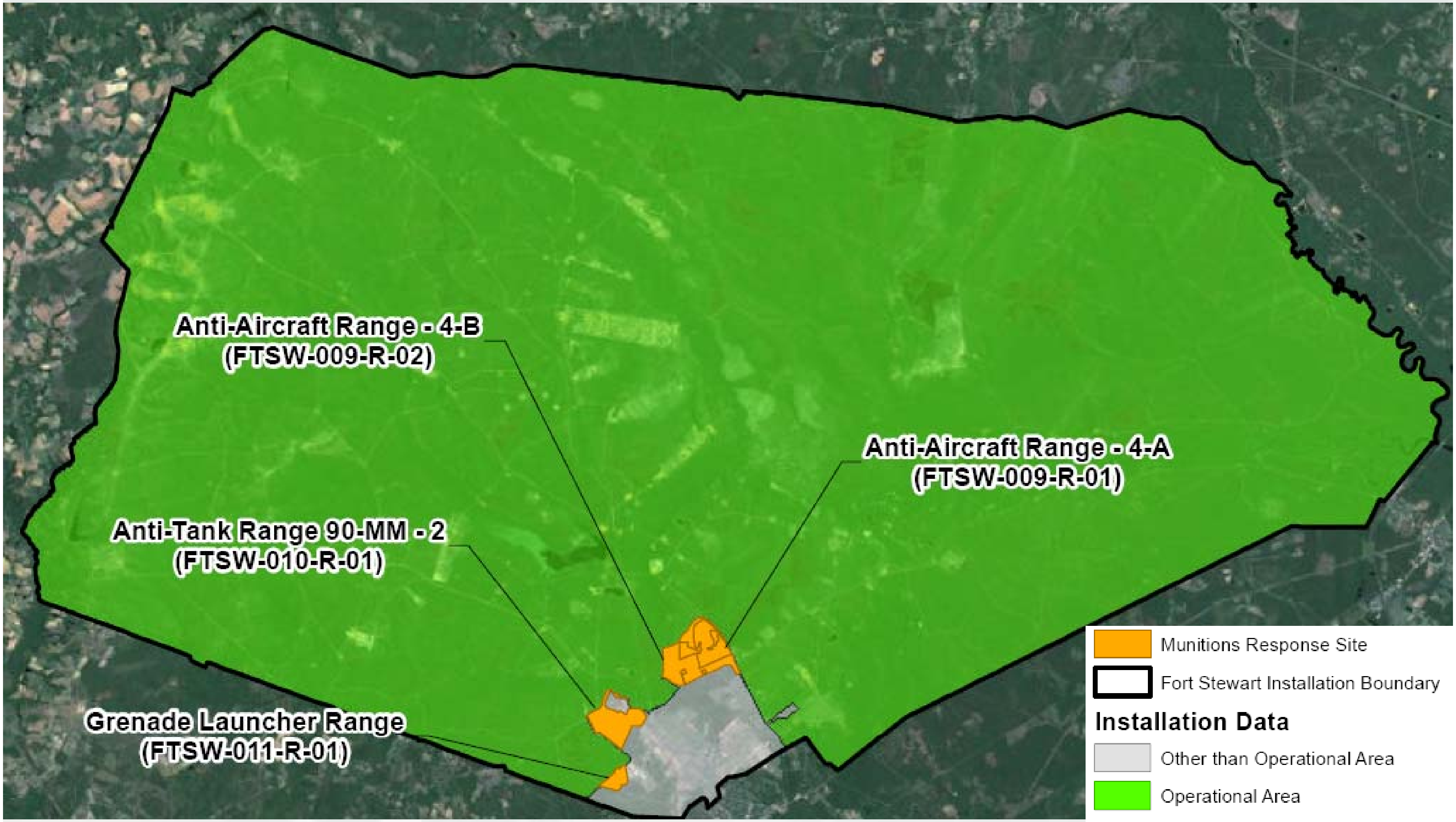
- Munitions Constituents (MC)
  - ► Any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions, including explosive and non-explosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions.
- Material Potentially Presenting an Explosive Hazard (MPPEH)
  - ► Material owned or controlled by the DoD that, prior to determination of its explosives safety status, potentially contains explosives or munitions or potentially contains a high enough concentration of explosives that the material presents an explosive.
- Material Documented as Safe (MDAS)
  - ► MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

Background Information

Fort Stewart, GA
Military Munitions Response Program

- Fort Stewart (FTSW) is located north of Hinesville, GA, approximately 40 miles southwest of Savannah, GA.
- FTSW is 279,081 acres in size and the largest Army installation east of the Mississippi River, spanning portions of Bryan, Evans, Liberty, Long, and Tattnall counties.
- Construction of the reservation that was to become FTSW began on September 10, 1940, on what was formerly the Camp Savannah Anti-Aircraft Firing Center.
- Four MRSs addressed under this contract for completion of RFI
  - FTSW-009-R-01: Anti-Aircraft Range 4A;
  - FTSW-009-R-02: Anti-Aircraft Range 4B;
  - FTSW-010-R-01: Anti-Tank Range 90-MM-2; and
  - FTSW-011-R-01: Grenade Launcher Range

Fort Stewart, GA



RFI Approach

Previous Investigations

- 2003 Closed, Transferring, and Transferred Range/Site Inventory Report
- 2006 Historical Records Review
- 2007 Confirmatory Sampling Report
- 2010 Phase 2 Historical Records Review
- 2011 MEC Quality Assurance (QA) Investigation to Depth of Detection at Anti-Aircraft Range – 4 MRS (FTSW-009-R-01)
- 2011 MEC Quality Assurance (QA) Follow-on Investigation to Depth of Detection at Anti-Aircraft Range – 4 MRS (FTSW-009-R-01)
- 2011 Army and Air Force Exchange Service (AFFES) Shoppette Highway 144 Construction Site at Anti-Aircraft Range – 4 MRS (FTSW-009-R-01)
- 2011 TCRA 10th Engineer Battalion Site & Dog Kennel Site
- 2012 Phase 2 Confirmatory Sampling Report

RFI Objectives

- RFI Objectives
  - Perform a RFI to define the nature and extent MEC and MC.
    - Investigation may be extended if items are identified near site boundaries, however, the investigation will not extend into the operational range
  - Assess MEC hazards and MC risks posed to human health and the environment
  - Utilize the RFI data to determine if further response is required pursuant to RCRA
- Tools used to characterize the nature and extent of MEC/MC may include:
  - Visual Surveys
  - Geophysical Surveys (see slides 15-16)
  - Statistically based sampling software (UXO Estimator/VSP)
  - Intrusive Investigations
  - Environmental Sampling

Geophysical Survey Tools Equipment

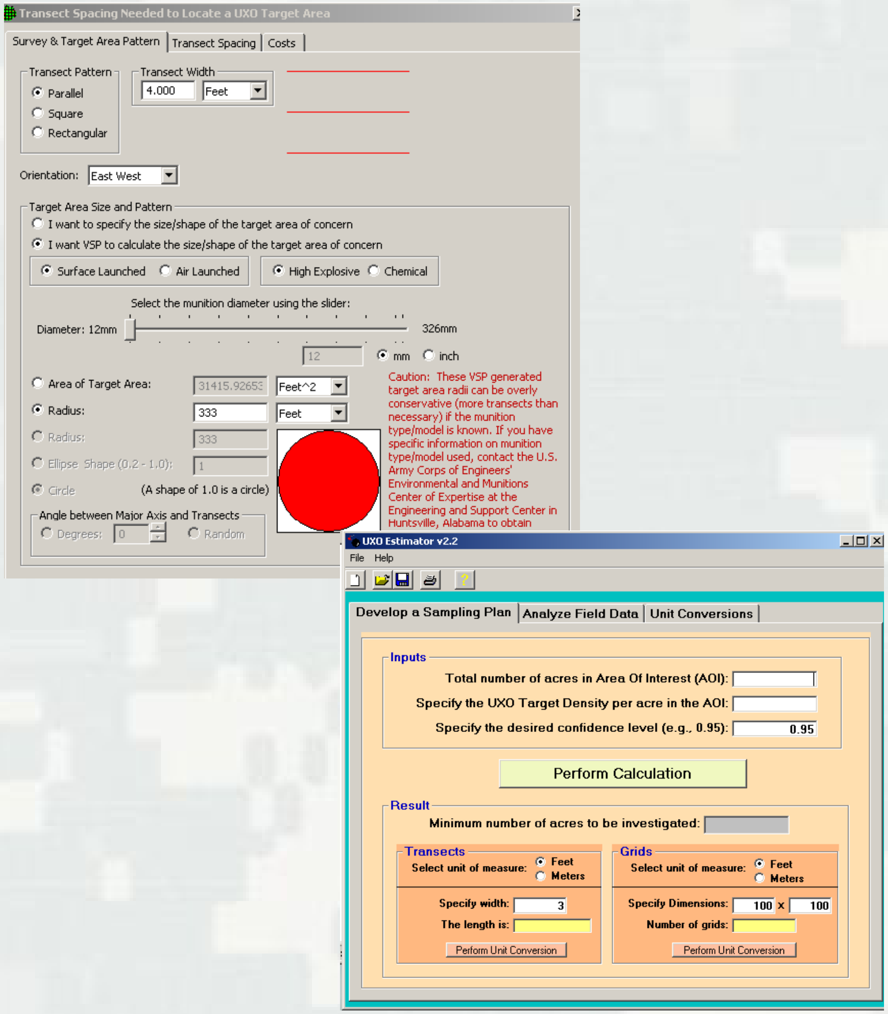
- Two types of geophysics used at MMRP sites:
  - Analog Geophysics utilizes handheld instruments, such as Schonstedt magnetometers, that alert the operator to anomalies with an audio signal.
  - Digital geophysical mapping (DGM) acquires geophysical data using self-recording instruments, such as the EM61-MK2. The data is post-processed to identify anomalies for investigation.

Analog geophysics

Digital Geophysical Mapping

Geophysical Survey Statistical Tools

- Two statistical tools often used at MMRP sites:
  - ▸ Visual Sample Plan "Transect Sampling for UXO Target Detection"
    - Used at sites where a target area, with elevated anomaly density, is anticipated
  - ▸ UXO Estimator
    - Used for sites where a random, homogenous distribution is anticipated



Data Quality Objectives

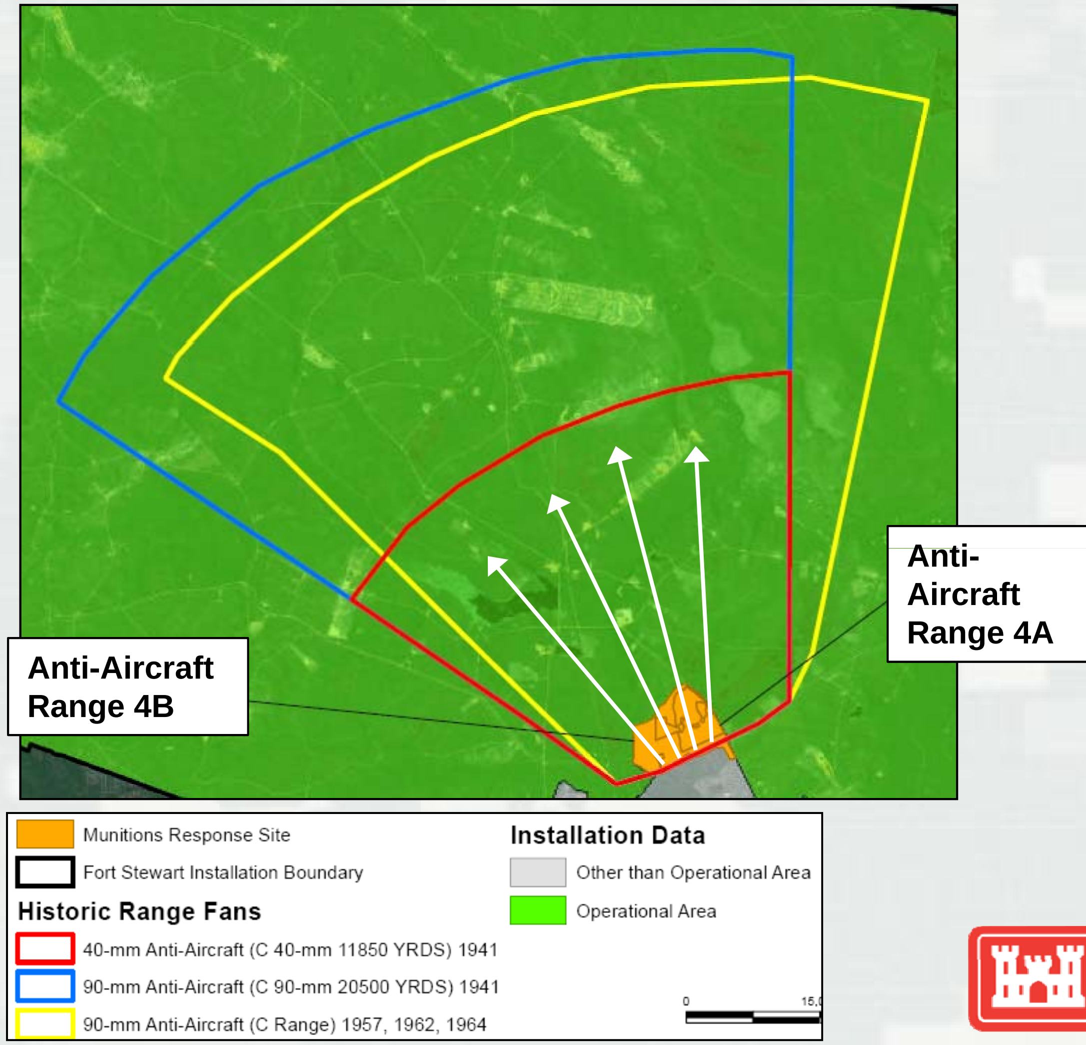
- In order to determine how to achieve the RFI objectives, Data Quality Objectives were developed for each MRS. They include:
  1. State the problem.
  2. Identify the decision.
  3. Identify inputs to the decision.
  4. Define the study boundaries.
  5. Develop a decision rule.
  6. Specify limits of decision errors.
  7. Optimize the design for obtaining data.

Site Details

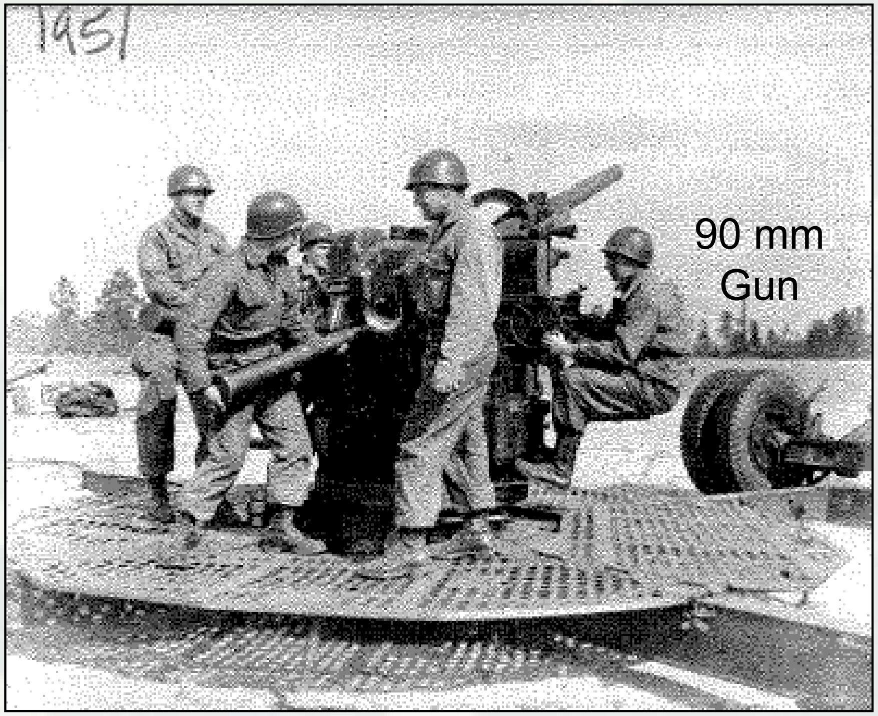
FTSW-009-R-01: Anti-Aircraft Range 4A;
FTSW-009-R-02: Anti-Aircraft Range 4B;
FTSW-010-R-01: Anti-Tank Range 90-MM-2; and
FTSW-011-R-01: Grenade Launcher Range

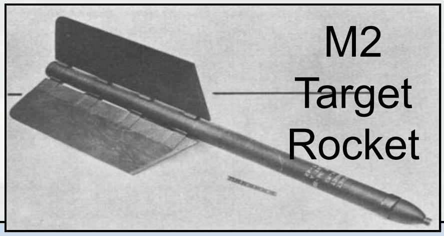
Anti-Aircraft Range 4A/B Background Information

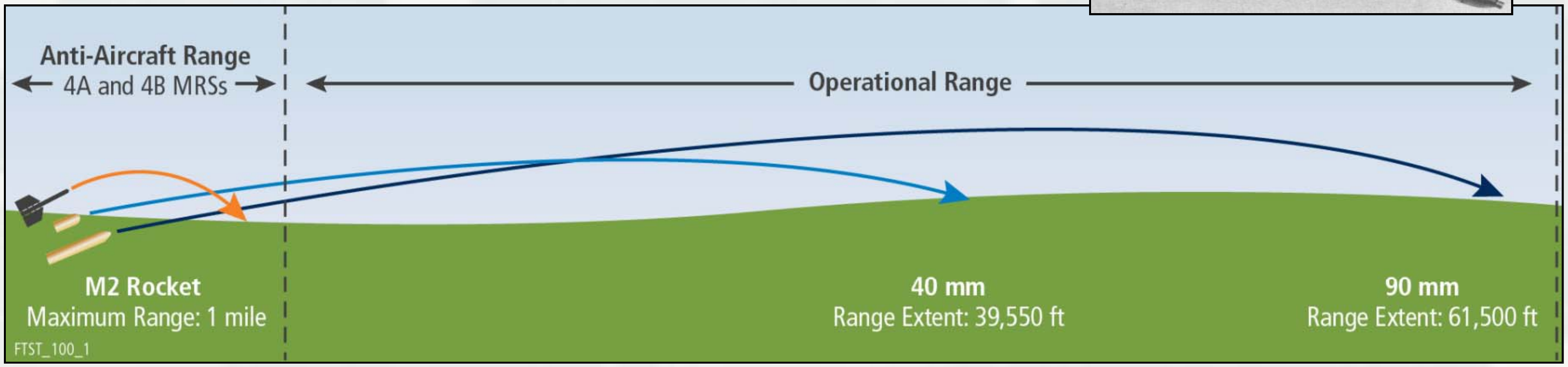
- Site History:
  - Firing points of a total of three separate/co-located anti-aircraft ranges (40mm and 90mm).
  - The exact location of the firing points has not been documented.
  - Range fans extended well beyond the MRS into the Operational Ranges of FTSW.



Anti-Aircraft Guns

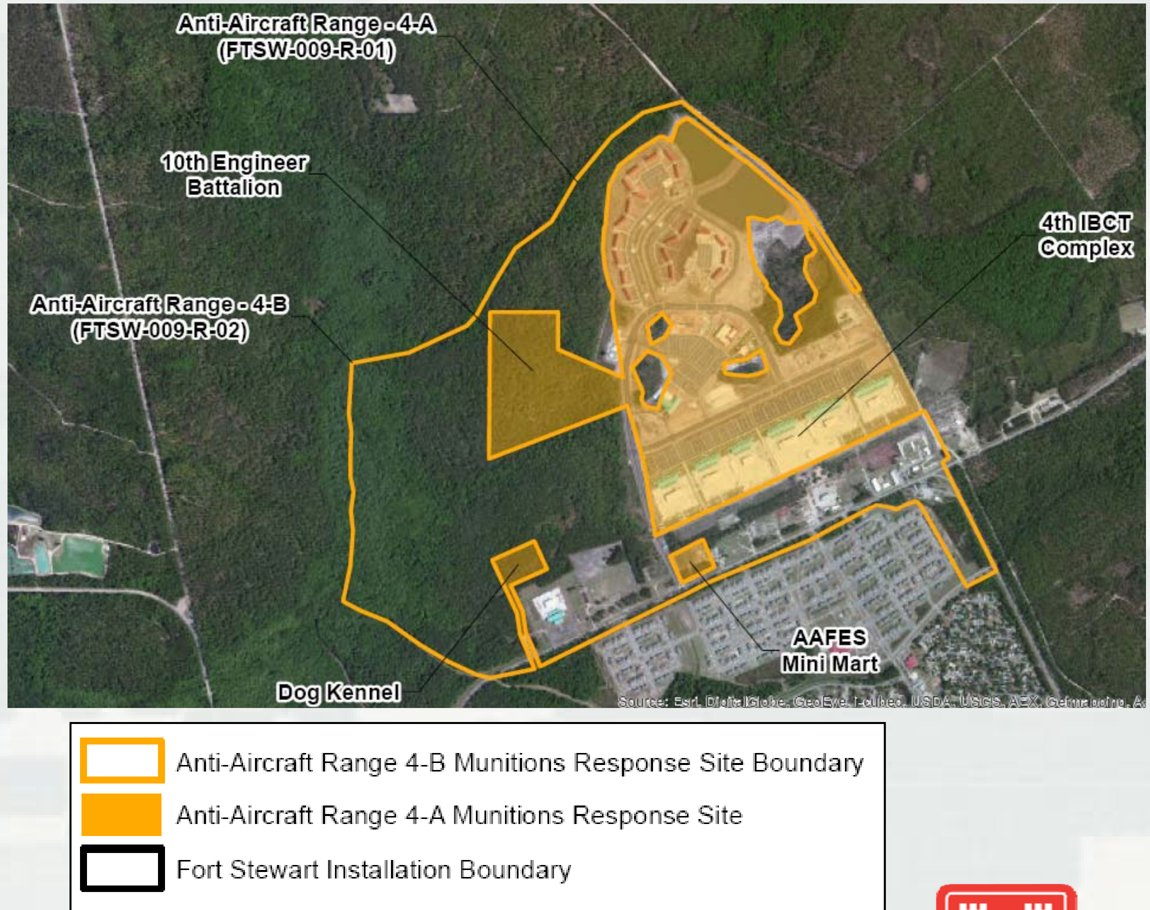




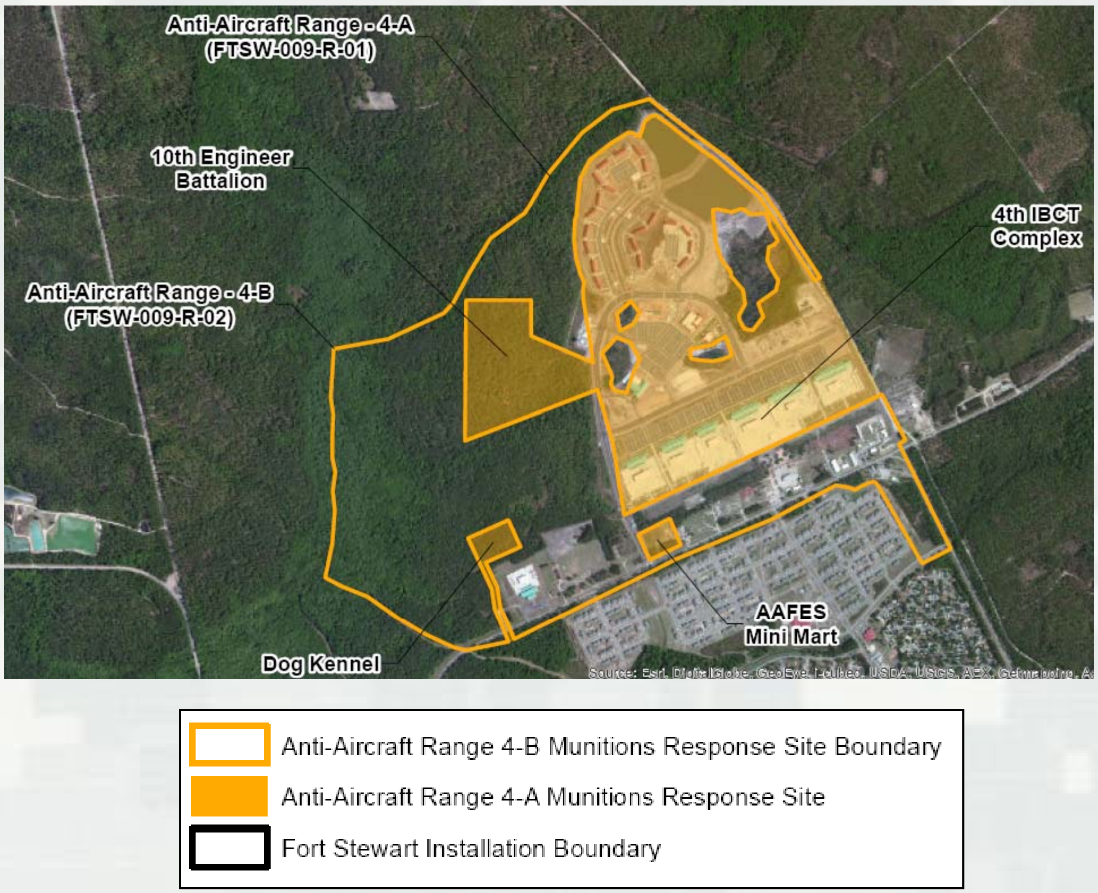


Anti-Aircraft Range 4A/B MRS Division

- MRS 4A (orange shading)
  - 465 acres where MEC investigations and removals were performed (see slides 25-31).
  - EOD responses occurred during recent construction, with limited documentation indicating mainly M2 target rockets, a 40mm projectile, and a 2.75” rocket
  - CENAB determined there is a low probability for encountering MEC (MEC QA Follow-On Investigation).
- MRS 4B (orange outline)
  - 663 acres that are largely undeveloped and uninvestigated.
  - Includes 8-acre projection on the southeast corner (due to a M67 hand grenade found during an EOD response).



Anti-Aircraft Range 4A/B Land Use

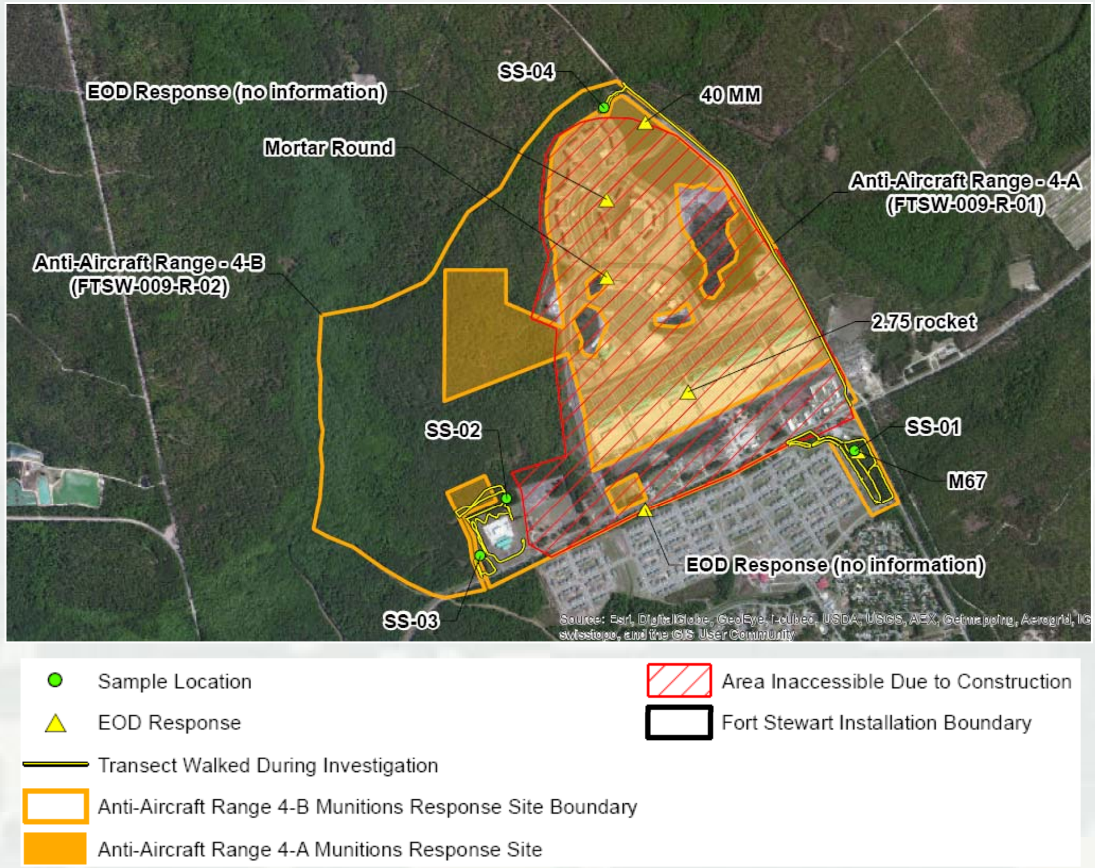


Current/Future Land Use:

- MRS 4A is recently developed residential and industrial. Construction on this site includes barracks facilities, operations facilities, tactical equipment maintenance facilities, Brigade/Battalion Headquarters facility, dining facility, a physical fitness center, and family care clinic.
- MRS 4B is mostly undeveloped land. The southern portion of 4B is a non-residential portion of the cantonment area with a horse stable and maintenance facility.

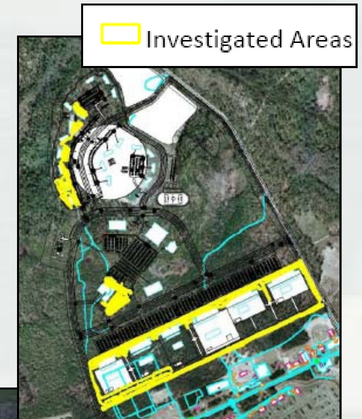
Anti-Aircraft Range 4A/B
Phase 2 Confirmatory Sampling

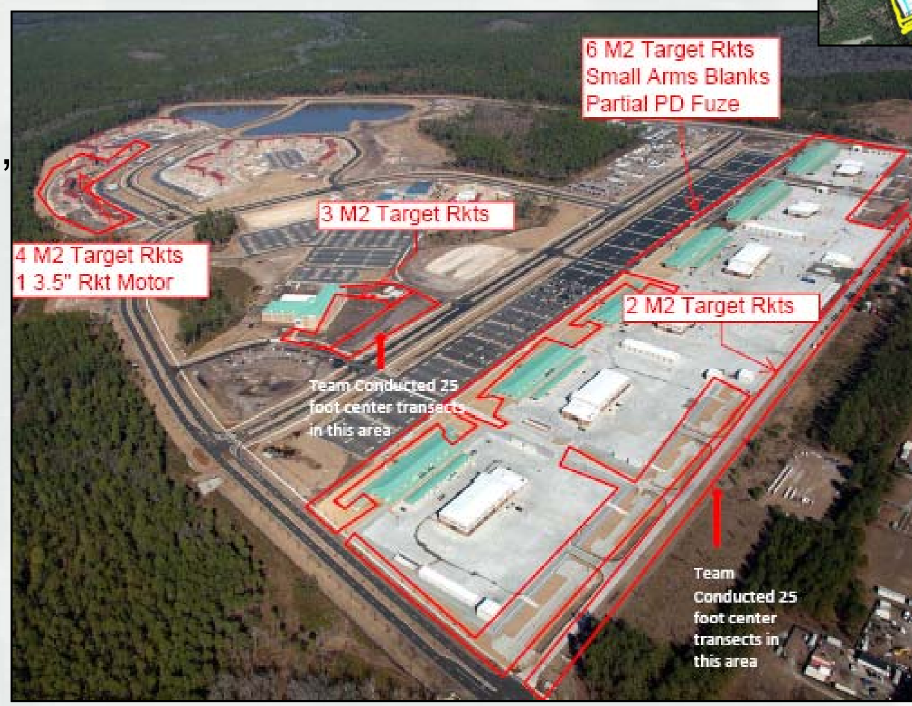
- Performed August 23 -26, 2010
- A magnetometer-assisted visual survey was conducted within accessible undeveloped areas of Anti-Aircraft Range 4B
- Four discrete surface soil samples analyzed for select metals and explosives at randomly distributed locations
  - Metals detected well below USEPA RSLs and Region 4 Ecological Screening Values
  - No explosives detected above method detection or laboratory reporting limits
- Recommendations: RFI/CMS for MEC.



Anti-Aircraft Range 4A
MEC QA Investigation

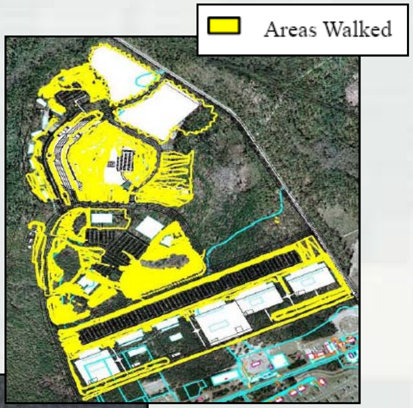
- Performed by CENAB 14-26 February 2011
- Investigated areas (in yellow) were searched using mag and flag/dig protocols with a Schonstedt magnetometer
- Over 2000 anomalies were investigated:
  - Mostly construction debris and trash
  - 7 small arms (50 caliber),
  - 16 MDAS items
    - M2 Target Rockets (15)
    - 3.5” rocket motor (1)
  - 1 MEC item
    - Point detonating fuze





Anti-Aircraft Range 4A
MEC QA Follow-on Investigation

- Performed by CENAB 11-29 April 2011
- Investigated areas (in yellow) were searched using mag and flag/dig protocols with Schonstedt magnetometer
- Over 3300 anomalies were investigated:
  - Mostly construction debris and trash
  - MDAS
    - M2 Target Rockets (54),
    - M2 Target Rocket Motors (19)
    - 81mm Practice Mortars (2)



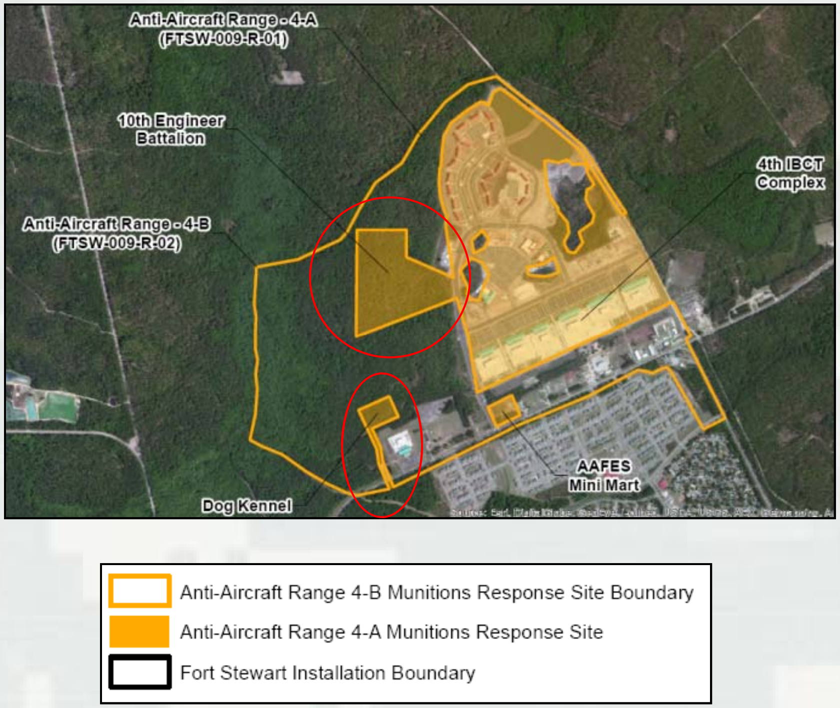
Anti-Aircraft Range 4A AAFES Shoppette Highway 144 Construction Site MEC Investigation

- Performed by CENAB 13-21 April 2011
- 5 acre site investigated using mag and flag/dig protocols with Schonstedt magnetometer
- Over 350 anomalies were investigated:
  - Mostly construction debris and trash.
  - A small pit (1.5’ x 2’ x 2’) with rusted out bodies of fuze shipping containers.

Pit of Fuze Shipping Containers
Fort Stewart Installation Boundary
Area Walked During MEC Investigation
Anti-Aircraft Range 4-A Munitions Response Site
Anti-Aircraft Range 4-B Munitions Response Site Boundary

Anti-Aircraft Range 4A
TCRA for 10th Engineering Battalion Site & Dog Kennel Site

- A surface and subsurface clearance was performed April – June 2011
- 10,780 pounds of debris was disposed during field operations
- 10th Engineering Battalion (67.9 acres)
  - Following items were found:
    - M2 BAT Rockets (MDAS)
    - Metal Fragments in various stages of decay (MDAS)
    - Target Debris
    - Braided Tow Cable
    - Pieces of Crashed Drone Planes
    - Miscellaneous Scrap
- Dog Kennel (9.9 acres)
  - Following items were found:
    - M2 BAT Rockets (MDAS)
    - Metal Fragments in various stages of decay (MDAS)
    - 20 mm Projectiles (MDAS)
    - Target Debris
    - Braided Tow Cable
    - Miscellaneous Scrap



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Anti-Aircraft Range 4A
TCRA for South Pond Site and HHQ

- South Pond Site
  - MEC removal performed on 25,000 CY of staged top soil
  - 1 MEC item, M79 90mm HE-T, was found and disposed by EOD
  - 29 MDAS items, all M2 BAT rockets, were found
- HHQ Site
  - MEC removal performed on 12,000 CY of soil.
  - 32 MDAS items, all M2 BAT rockets, were found

Anti-Aircraft Range 4A/B MEC Conceptual Site Model

- **Source:**
  - Anti-Aircraft Range 4A/4B are the firing points and vicinity of three co-located anti-aircraft ranges (40mm and 90mm). Troops may have also left DMM close to the firing points.
  - Previous findings: Numerous M2 target rockets, occasional 90mm and 40mm projectiles, and isolated finds (2.75” rockets, 3.5” rockets, 81mm practice mortars, 20mm projectiles, M67 hand grenades).
  - Stray munitions are occasionally observed across military installations, so items not associated with the site history may be observed.
  - With no evidence of stationary land-based targets in the site history and previous finds, homogenous MEC/MDAS distribution is anticipated in the surface and subsurface of the MRS.

Anti-Aircraft Range 4A/B
MEC Conceptual Site Model

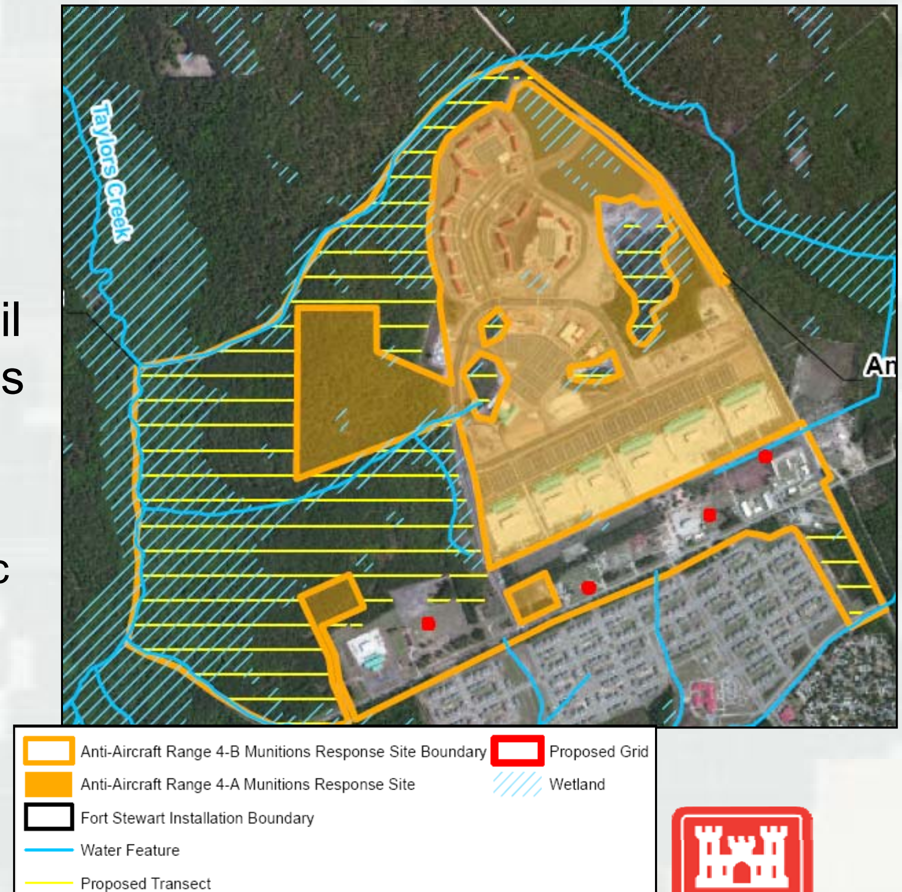
- **Activity:**
  - Anti-Aircraft Range 4A is a developed residential area. Anti-Aircraft Range 4B is mostly undeveloped.
  - Walking in undeveloped area may pose a potential surface MEC exposure concern.
  - Construction activities pose a potential subsurface MEC exposure concern.
- **Access:**
  - No access restrictions are present to most areas once on FTSW property.
- **Receptors:**
  - Installation personnel/contractors/residents, construction workers, trespassers, and biota.

Anti-Aircraft Range 4A/B Data Quality Objectives

1. State the problem.
   - MEC has already been confirmed to be present in MRS 4A based on previous finds. The previous investigations support a low probability for encountering MEC at MRS 4A.
   - MEC (including DMM) is likely to also be present in MRS 4B.
   - If exposed filler or a disposal pit is found where MC may be concentrated, there is a potential for environmental impacts from MC.
2. Identify the decision.
   - What is the nature and extent of MEC (including DMM) and MC?
   - Are there unacceptable MEC hazards or MC risks from previous activities at the MRS?

Anti-Aircraft Range 4A/B Data Quality Objectives

3. Identify inputs to the decisions
   - Historical use of MRS
   - EOD response information
   - MEC QA investigation and TCRA data (particularly useful in MRS 4A)
   - August 2010 Confirmatory Sampling soil sampling data (four surface soil samples analyzed for metals and explosives)
   - RFI Investigation
     - MEC investigation for subsurface metallic items in MRS 4B, primarily in transects
     - MEC investigation at firing points where DMM could be present
     - MC sample results (if appropriate)



Anti-Aircraft Range 4A/B
Data Quality Objectives

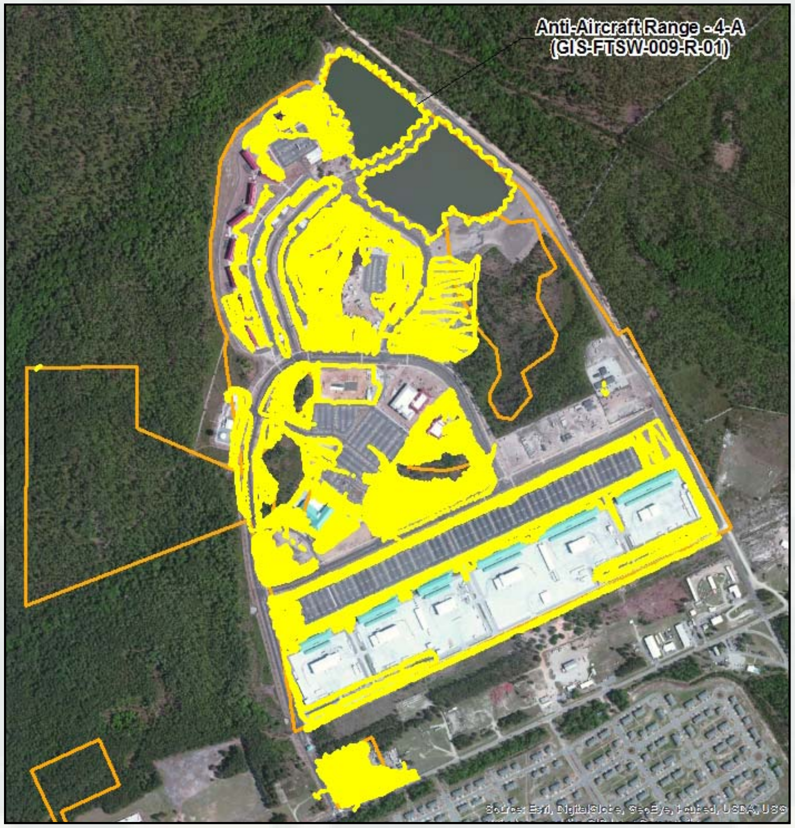
4. Define study boundary.
   - ► Anti-Aircraft Range 4A represents 465 acres where MEC investigations and removals were performed by CENAB.
   - ► Anti-Aircraft Range 4B represents 663 acres that remains largely undeveloped and uninvestigated.
   - ► The MRSs are bound by the operational range to the north.
5. Develop decision rules.
   - ► If MEC is found
     - Determine the nature and extent of MEC in the area
     - Perform a MEC Hazard Assessment
   - ► If a potential MC release (i.e., exposed filler, DMM pit, or small arms berm) is observed
     - Collect MC sample(s) to delineate contamination (if any)
     - Perform a risk assessment, if MC in soil is detected above screening levels
     - Investigate other media, if migration is a concern.

Anti-Aircraft Range 4A/B
Data Quality Objectives

6. Specify tolerable limits on decisions.
   - UXO Estimator will be used to statistically determine sampling area with a 95% confidence limit and a target UXO density of 0.5 UXO/acre
   - Geophysicists will develop criteria for determining whether anomalies at firing points represent potential DMM burial pits. A statistical percentage of these will be investigated using VSP module.
   - Validation of analytical MC data will be performed per DoD QSM for data evaluation/risk screening
7. Optimize the Design
   - Evaluate both MRSs together in the RFI
     - Operational history and physical boundaries of the two MRSs are fully intertwined
     - Sharing data strengthens CSM and conclusions
   - UXO Estimator utilized to determine coverage
     - UXO Estimator calculates upper bound of MEC density assuming homogeneous, random distribution. Since no fixed target areas are anticipated within this MRS, this is a valid assumption.
   - Additional Firing Point Investigation
     - Additional investigation proposed to determine whether DMM is present.

Anti-Aircraft Range 4A
Step 7. Optimizing the Design

- Utilize existing data collected during previous investigations and removals
  - CENAB investigations and removals covered ~200 of the 465 acres
  - Two MEC items found (point detonating fuze and 90mm projectile)
  - UXO Estimator calculates with 95% probability that there is less than 0.017 UXO per acre
- No additional data needed



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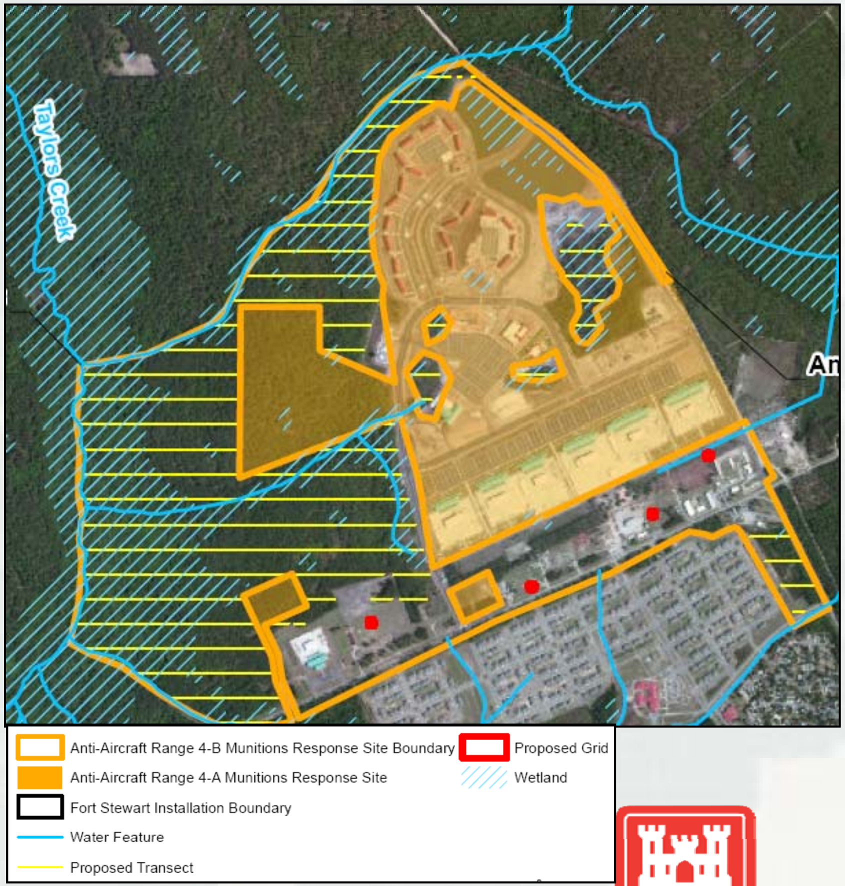
Anti-Aircraft Range 4B
Step 7. Optimizing the Design

- Collect 6 acres of MEC investigation data on 12 miles of transects (325 ft spacing) plus 4 grids (50'x50').
  - Transects may be moved to avoid wetlands based on site conditions
- Use analog geophysics with Schonstedt magnetometer
  - Analog approach more efficient than DGM under tree cover where GPS accuracy is low
  - Will detect 40mm and 90mm projectiles to penetration depth (0.2 ft and 2.0 ft)
  - Consistent with instrument used in MRS 4A
- Additional geophysics (DGM) will be collected at the firing points to identify potential DMM burial pits.
- Instrument-aided surface inspection on 8 acres where M67 grenade was found

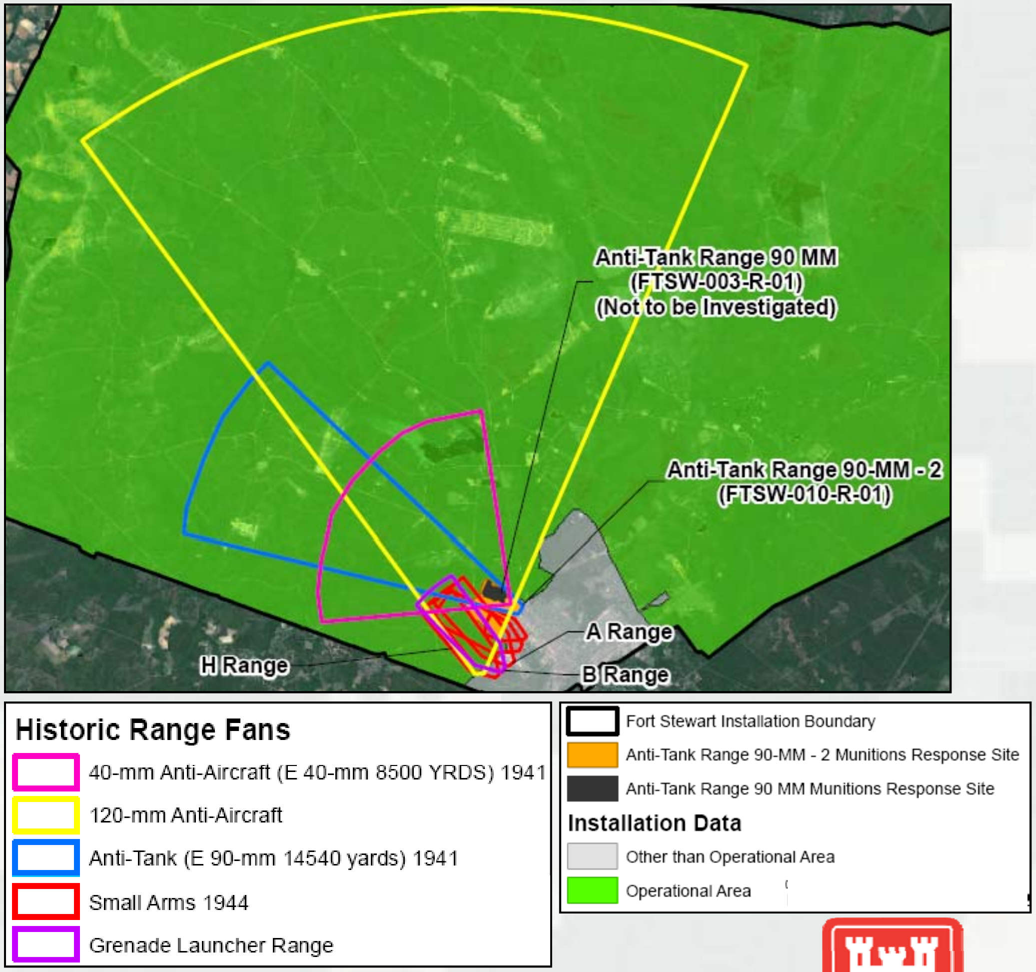


Anti-Aircraft Range 4A/B
Step 7. Optimizing the Design

- Munitions Constituents (MC)
  - ► Based on previous investigations at similar ranges, unacceptable MC risk is not anticipated unless there are high concentrations of MEC with exposed fillers, burial pits containing DMM, or small arms berms.
  - ► Previous CS sample results support this with no contaminants exceeding screening levels.
  - ► Additional MC sampling is not proposed unless exposed fillers, burial pits containing DMM, or small arms berms are found.
  - ► Surface water, sediment, and groundwater sampling is not anticipated to be required unless significant MC concentrations are found in soil

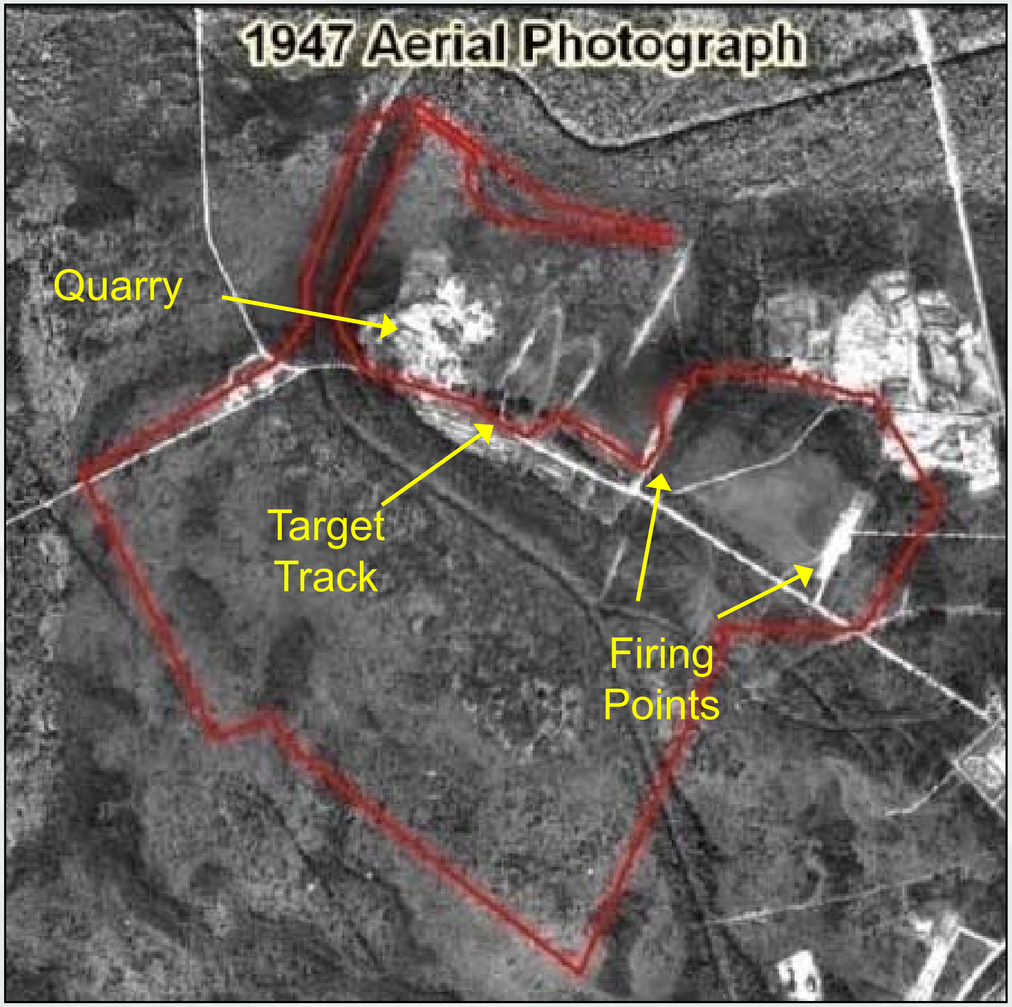
Anti-Tank Range 90-MM-2 Background Information

- Site History:
  - 546 acres
  - Used for anti-tank, anti-aircraft, grenade launcher, and small arms training during the 1940s
  - Firing points on east now covered by motor pool and fueling station
  - Range fans extended well beyond the MRS into the Operational Ranges of FTSW
  - The Anti-Tank Range 90-MM MRS, which contains the active landfill (shown in black), is not part of the MRS
  - MRS partially overlaps small arms, and grenade launcher range, and 120mm anti-aircraft range fans that fired from slightly south of the MRS
- Current/Future Land Use:
  - Partially forested and grasslands, and partially comprised of the non-residential cantonment area



Anti-Tank Range 90-MM-2 Background Information

- 1947 Site Features

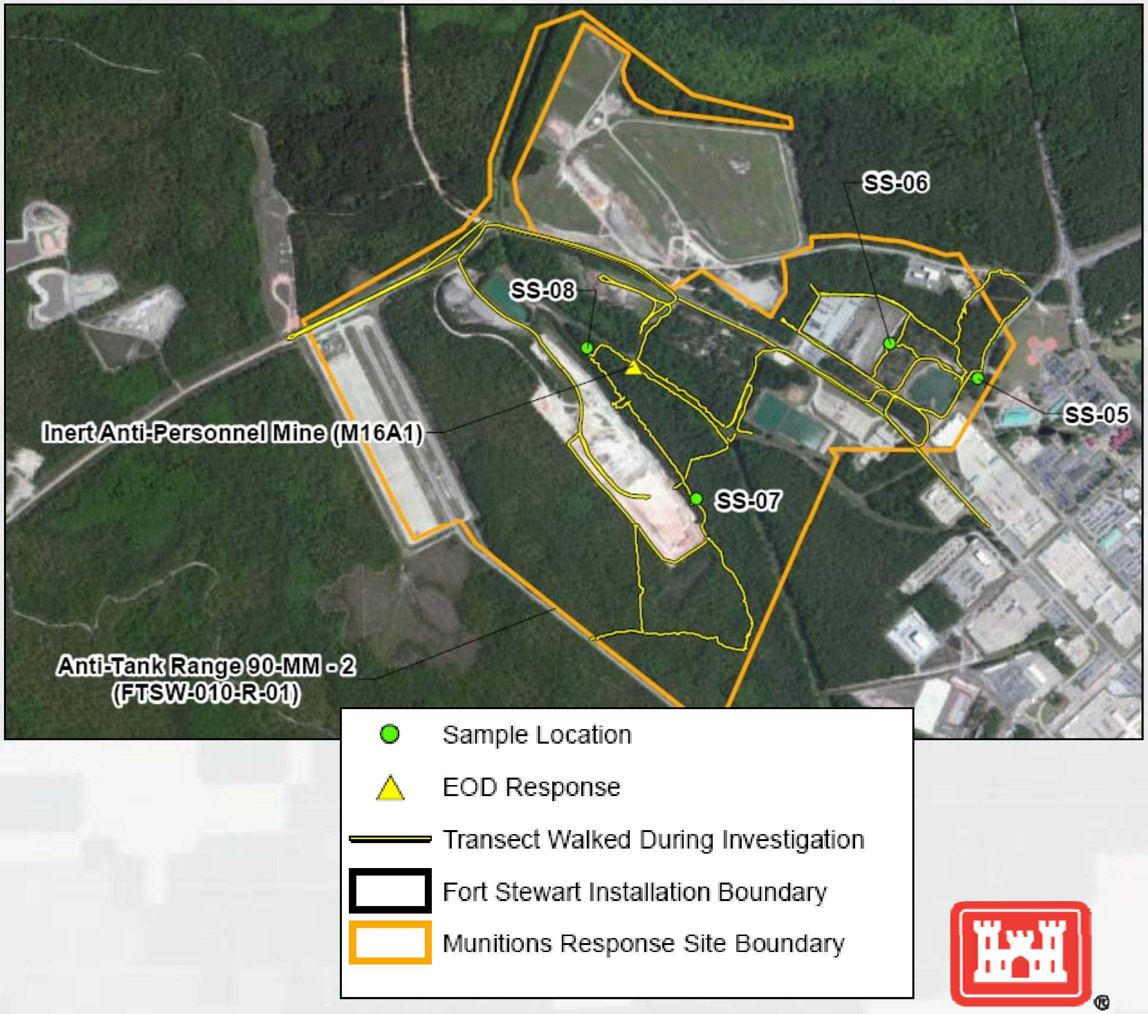


Anti-Tank Range 90-MM-2
Phase 2 Confirmatory Sampling Report

- Performed 8/23/10 - 8/26/10
- Magnetometer assisted visual survey conducted through undeveloped portions of the MRS.
  - Focused on the two suspected firing points (circled in red).
  - One MDAS item (inert M16A1 anti-personnel mine) was observed on the ground surface

Anti-Tank Range 90-MM-2
Phase 2 Confirmatory Sampling Report

- MC sampling
  - Four surface soil samples analyzed for select metals and explosives (2 collected from suspected firing lines).
  - Zinc: No samples exceeded USEPA RSL. One (SS-06) exceeded FTSW background and USEPA Region 4 ESV.
  - Lead: No samples exceeded USEPA RSLs or USEPA Region 4 ESV. One (SS-06) exceeded FTSW background.
  - Other metals: Al, Sb, and Cu were below USEPA RSLs and Region 4 ESVs.
  - Explosives: None detected above MDLs.
- Recommendations: RFI/CMS for MEC



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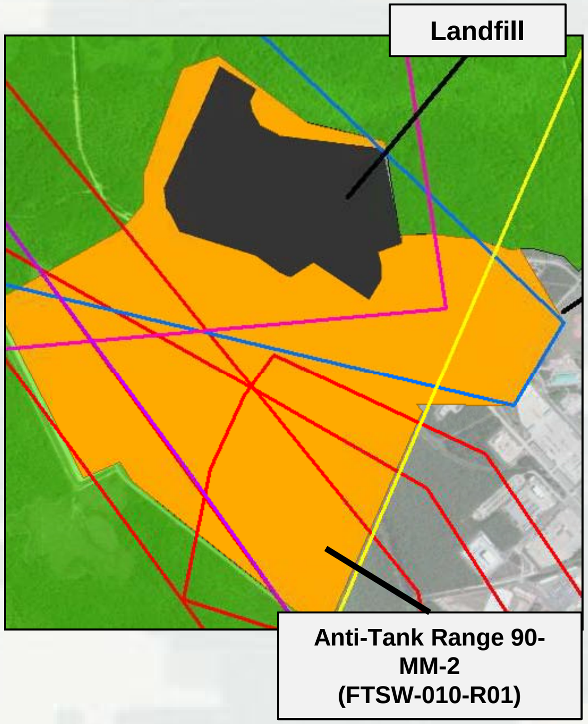
Anti-Tank Range 90-MM-2
MEC Conceptual Site Model

- **Source:**
  - MRS is composed of the firing point of two separate co-located ranges (90mm and 40mm) and the downrange area of several small arms ranges, a grenade launcher range, and a 120mm anti-aircraft range.
  - The large areal extent and layout of the range fans and relatively small size of the MRS near the firing points suggest that the 40mm, 90mm, and 120mm projectiles are not likely to be found in large numbers within the MRS.
  - Previous findings: One MDAS item (inert M16A1 anti-personnel mine).
  - Stray munitions are occasionally observed across military installations, so items not associated with the site history may be observed.
  - Troops may have left DMM close to the firing points.
  - Based on this information, there is the potential for MEC/MDAS as well as small arms in the surface and subsurface. Since no target areas are located within the MRS, homogenous distribution is anticipated.



Anti-Tank Range 90-MM-2
MEC Conceptual Site Model

- **Activity:** MRS is comprised of undeveloped land and the non residential cantonment area
- **Access:** No access restrictions to most areas once on FTSW property
- **Receptors:** Installation Personnel, contractors, trespassers, and biota

Anti-Tank Range 90-MM-2
Data Quality Objectives

1. State the problem.
   - There is a potential for MEC (including DMM) based on the anti-tank, anti-aircraft, and grenade launcher training activities that historically occurred.
   - If exposed filler, DMM pit, or small arms berms are observed, there is a potential for environmental impacts from MC.
2. Identify the decision.
   - What is the nature and extent of MEC (including DMM) and MC?
   - Are there unacceptable MEC hazards or MC risks from previous activities at the MRS?

Anti-Tank Range 90-MM-2
Data Quality Objectives

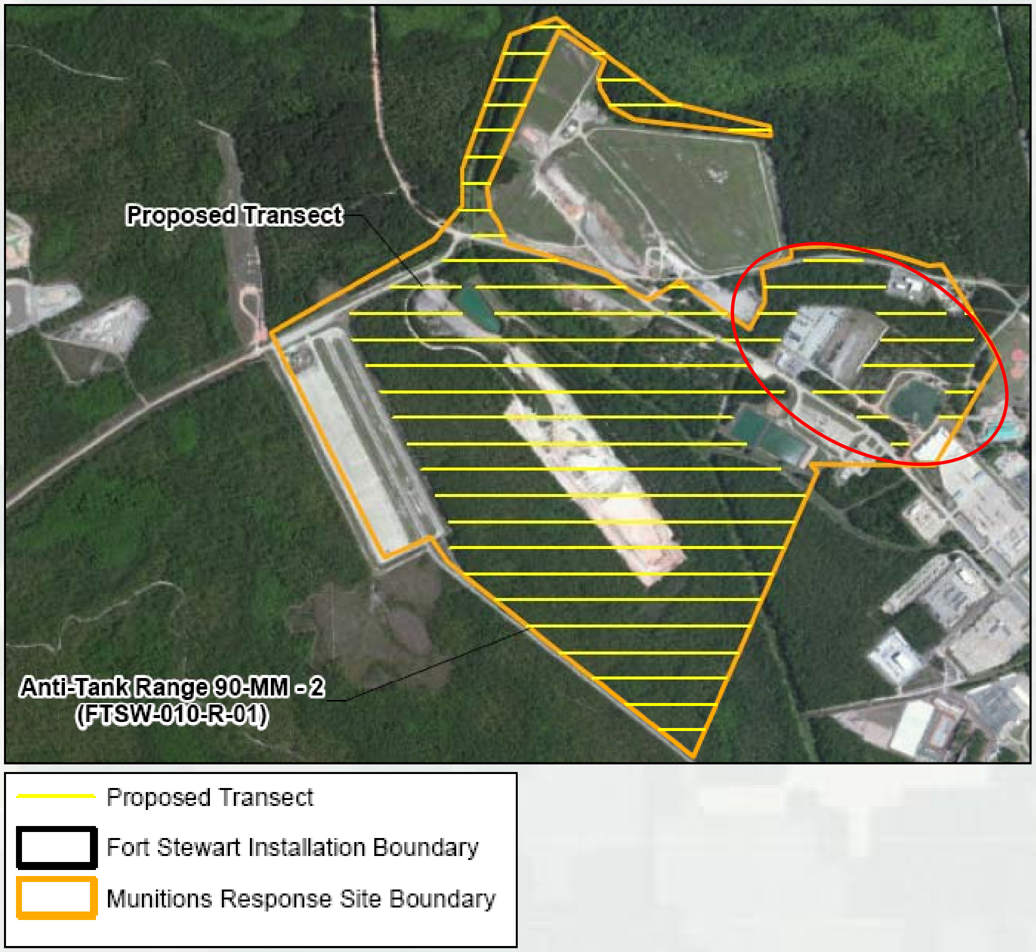
3. Identify inputs to the decisions
   - Historical use of MRS
   - EOD response information
   - Confirmatory Sampling survey and soil sampling data
   - RFI field activities
     - MEC investigation for subsurface metallic items
     - MEC investigation at firing points where DMM could be present
     - MC sample results (if required)

4. Define study boundary.
   - Anti-Tank Range 90-MM-2 represents 546 acre MRS that was identified during the Phase 2 CS Report. Does not include the landfill.
   - The MRS is bound by the operational range to the north.

Anti-Tank Range 90-MM-2
Data Quality Objectives

5. Develop decision rules.
   - ► If MEC is found
     - Determine the nature and extent of MEC in the area
     - Perform a MEC Hazard Assessment
   - ► If a potential MC release (i.e., exposed filler, DMM pit, or small arms berm) is observed
     - Collect MC sample(s) to delineate contamination (if any)
     - Perform a risk assessment, if MC in soil is detected above screening levels
     - Investigate other media, if migration is a concern.
6. Specify tolerable limits on decisions.
   - ► UXO Estimator to statistically determine sampling area with a 95% confidence limit and a target UXO density of 0.5 UXO/acre
   - ► Geophysicists develop criteria to identify potential DMM burial pits from DGM data collected at firing points. Use VSP to determine a statistical percentage to investigate.
   - ► QC program will be conducted to account for the Schonstedt detecting 120mm projectile
   - ► Validation of analytical MC data will be performed per DoD QSM for data evaluation/risk screening

Anti-Tank Range 90-MM-2
Step 7. Optimizing the Design



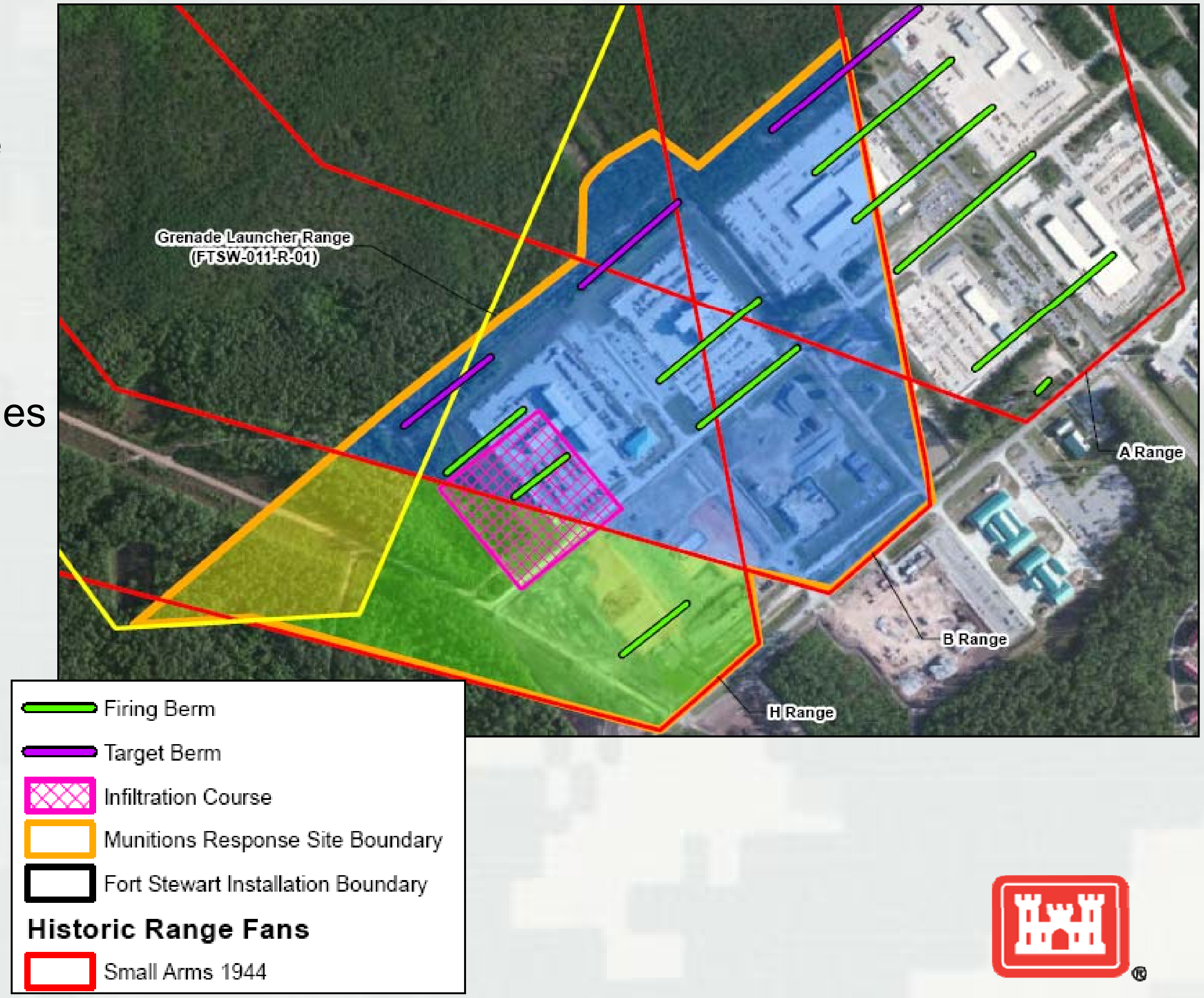
- Collect approximately 6 acres of data
  - 2.6 miles of transects (272 ft spacing)
  - Since no fixed target areas are anticipated within this MRS, UXO Estimator was utilized to determine coverage.
- Analog geophysics with Schonstedt magnetometer
  - Will detect 90mm projectiles to depth of penetration (2 ft)
  - Will detect 120mm projectiles to 4 ft
- Additional geophysics (DGM) will be collected at the firing points (circled in red) to identify DMM.

Anti-Tank Range 90-MM-2
Step 7. Optimizing the Design

- Munitions Constituents (MC)
  - Based on previous investigations at similar ranges, unacceptable MC risk is not anticipated unless there are high concentrations of MEC with exposed fillers, burial pits containing DMM, or small arms berms.
  - Previous CS sample results support this with no contaminants exceeding RSLs.
  - Additional MC sampling is not proposed unless exposed fillers, burial pits containing DMM, or small arms berms are found.
  - Surface water, sediment, and groundwater sampling is not anticipated to be required unless significant MC concentrations are found in soil

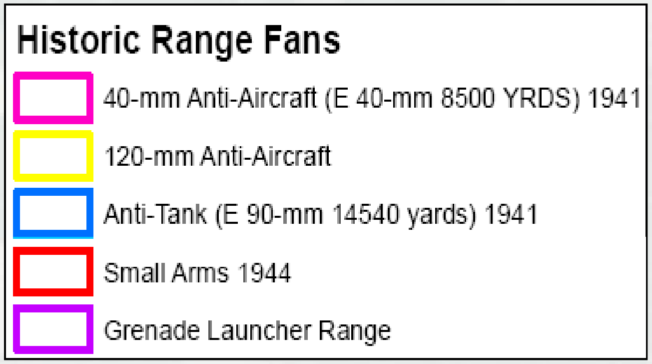
Grenade Launcher Range MRS Background Information

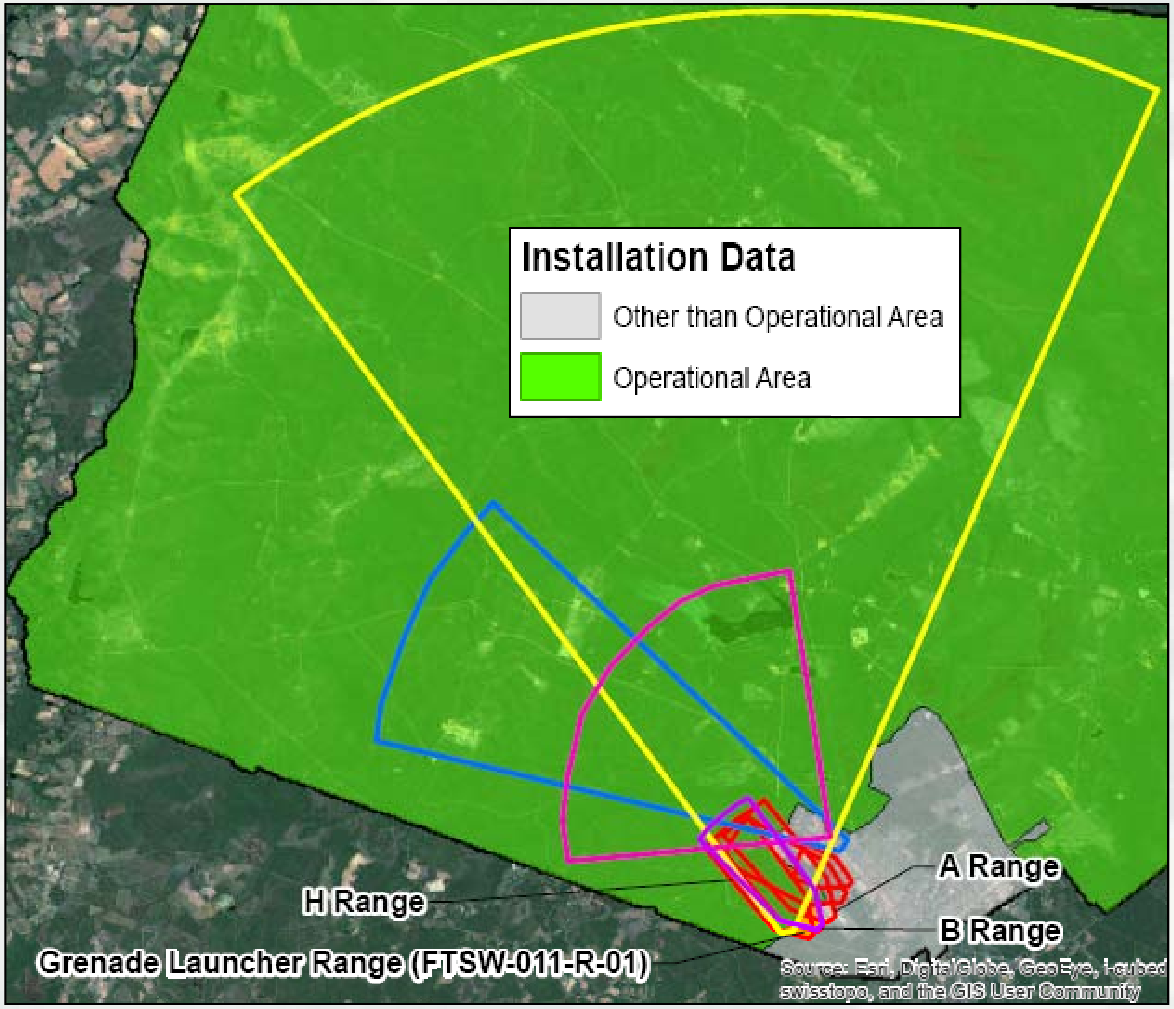
- Site History
  - 143 acres, used since the 1940s
  - Small Arms Ranges H, B, and A.
  - Range B (blue) also used for 40mm practice grenades
  - Range H also used as an infiltration course
  - Firing point for 120mm projectiles (yellow)
- Current/Future Land Use:
  - Recent industrial construction
  - Approximately 77 acres covered by buildings, concrete, etc.



Grenade Launcher Range MRS Background Information

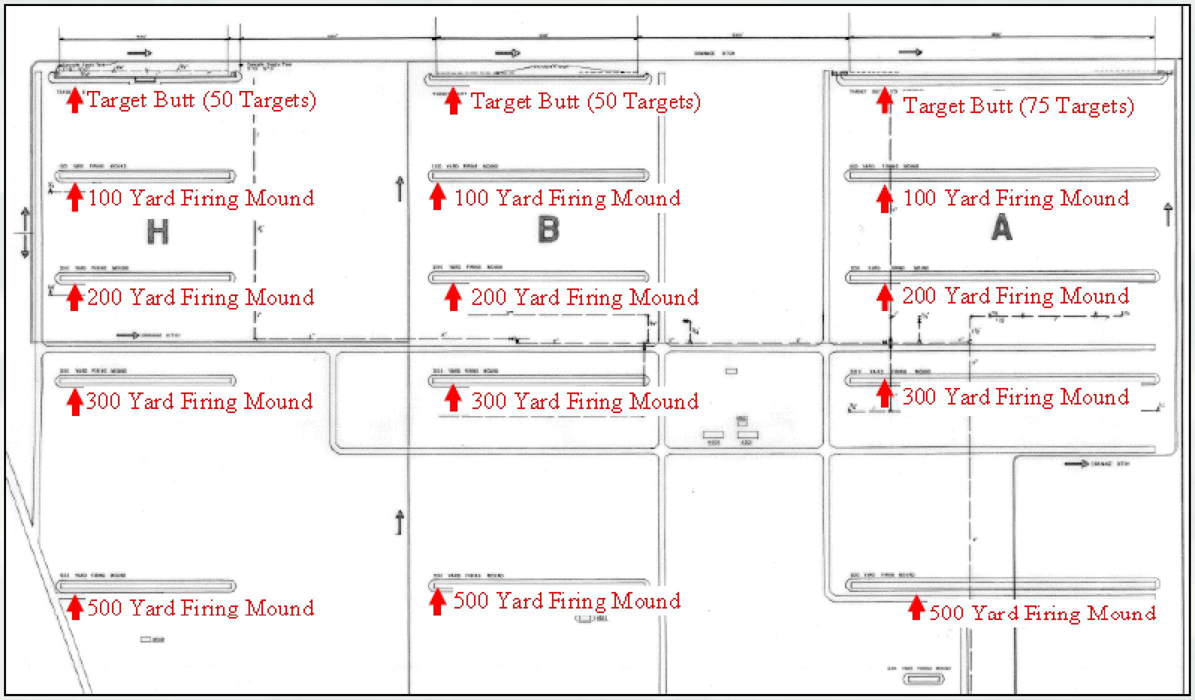
- Most of the 120mm range fan is in the operational area of Fort Stewart

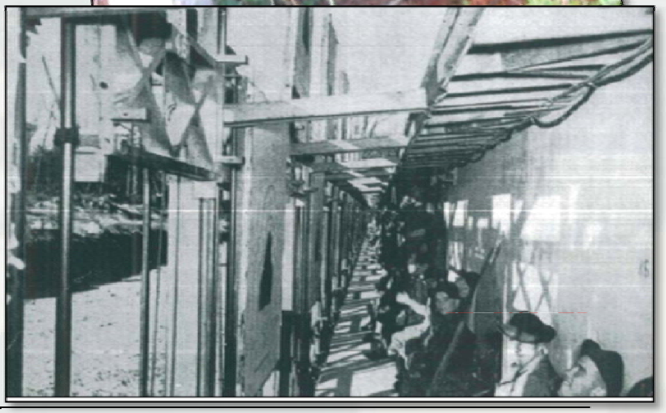




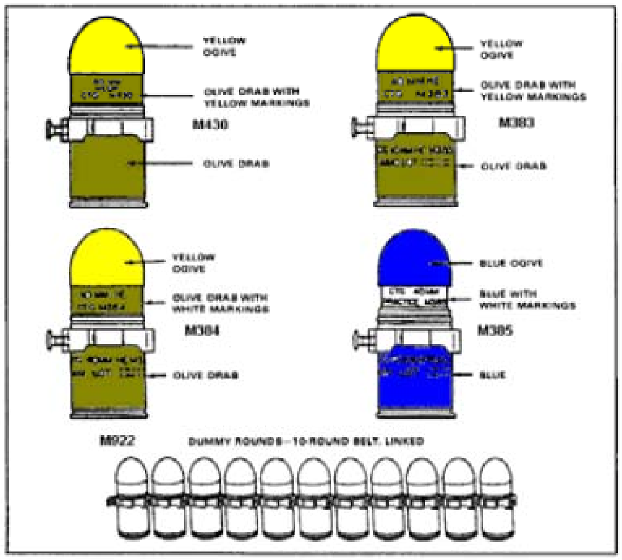
Grenade Launcher Range MRS
Small Arms Ranges H, B, and A

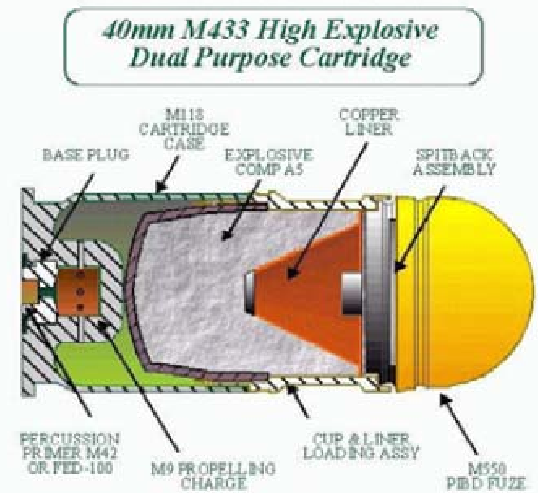
- Multiple firing mounds were used to vary distance.
- Target Butts were constructed of a concrete walls with soil piled along the face. Targets could be raised above the berm and lowered for replacement during firing exercises.

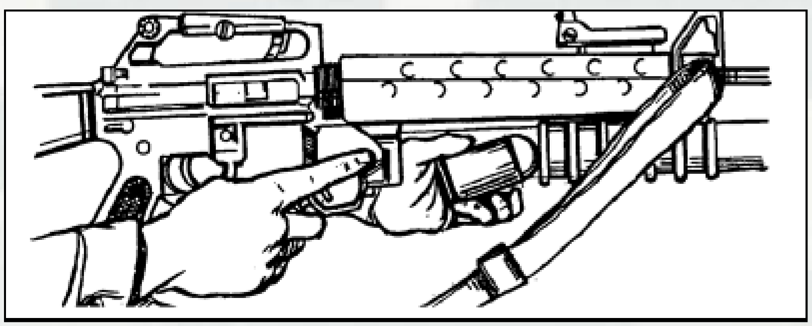




Grenade Launcher Range MRS
40 mm Grenade Launcher

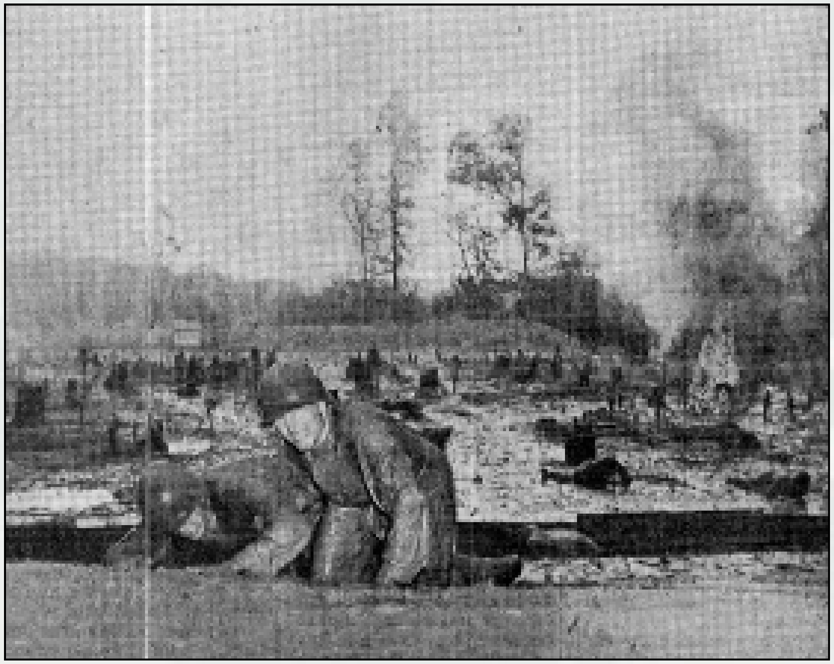


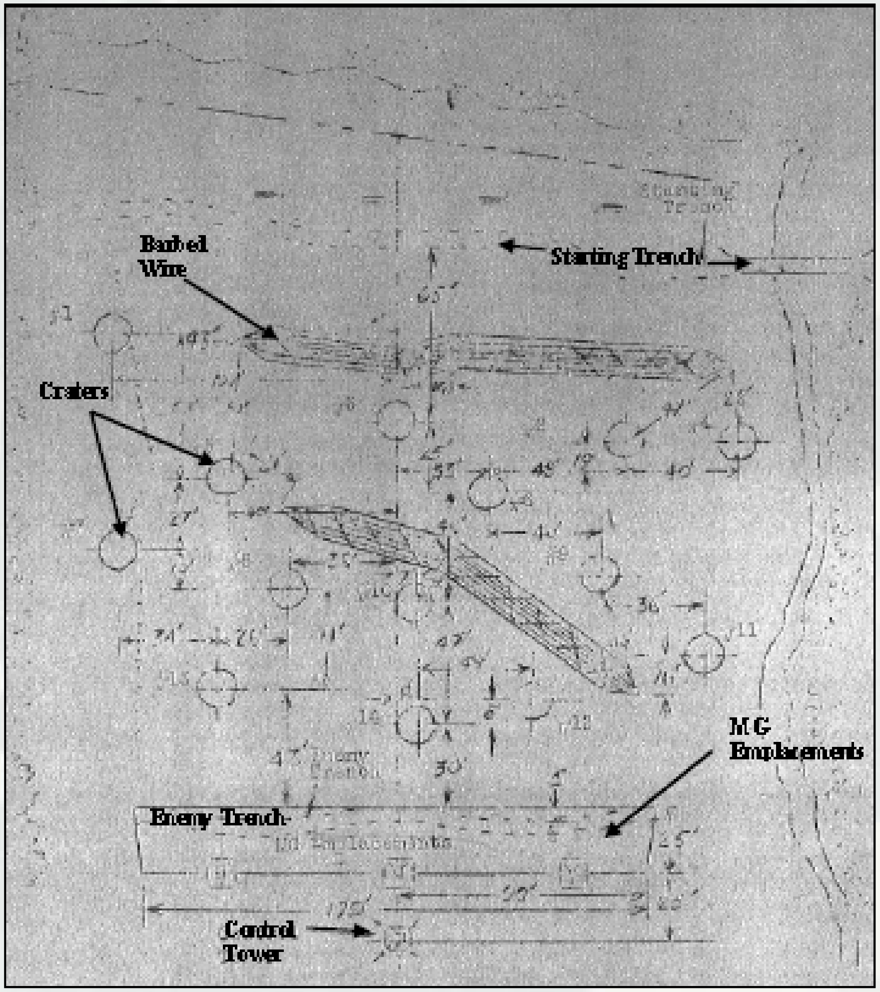




Grenade Launcher Range MRS Infiltration Course

- Range H was also used as an approximate 9.2-acre infiltration course (.30-cal machine gun firing and detonations of TNT to simulate battle conditions

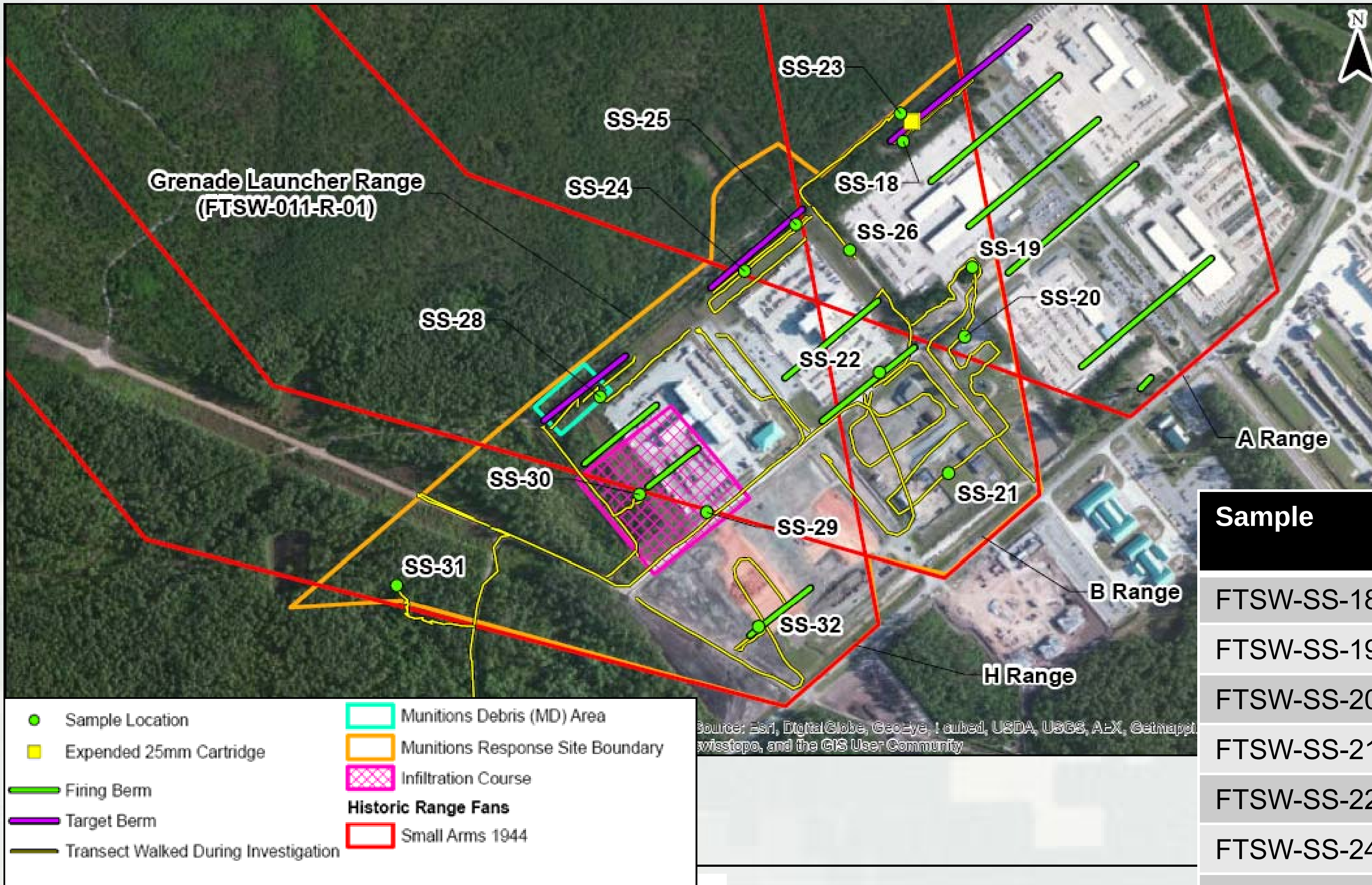




Grenade Launcher Range
Phase 2 Confirmatory Sampling Report

- Performed August 23 -26, 2010
- Magnetometer assisted visual survey conducted over 10% of the undeveloped area (approximately 4 acres).
  - Pop flares (expended), empty ammo cans, and expended small arms cartridges were observed
- MC sampling
  - Fourteen discrete surface soil samples collected.
  - Samples analyzed for select metals and explosives.
    - Lead: Lead was detected at a maximum concentration of 61.4 mg/kg. None of the samples collected exceeded the USEPA RSL for lead. Three of the samples exceeded the ESV. Nine samples exceeded the FTSW background.
    - Other metals: Aluminum, antimony, copper, and zinc did not exceed the USEPA RSLs or the USEPA Region 4 ESV.
    - Explosives: No explosives were detected above laboratory detection or method reporting limits.
- Recommendations: RFI/CMS for MEC

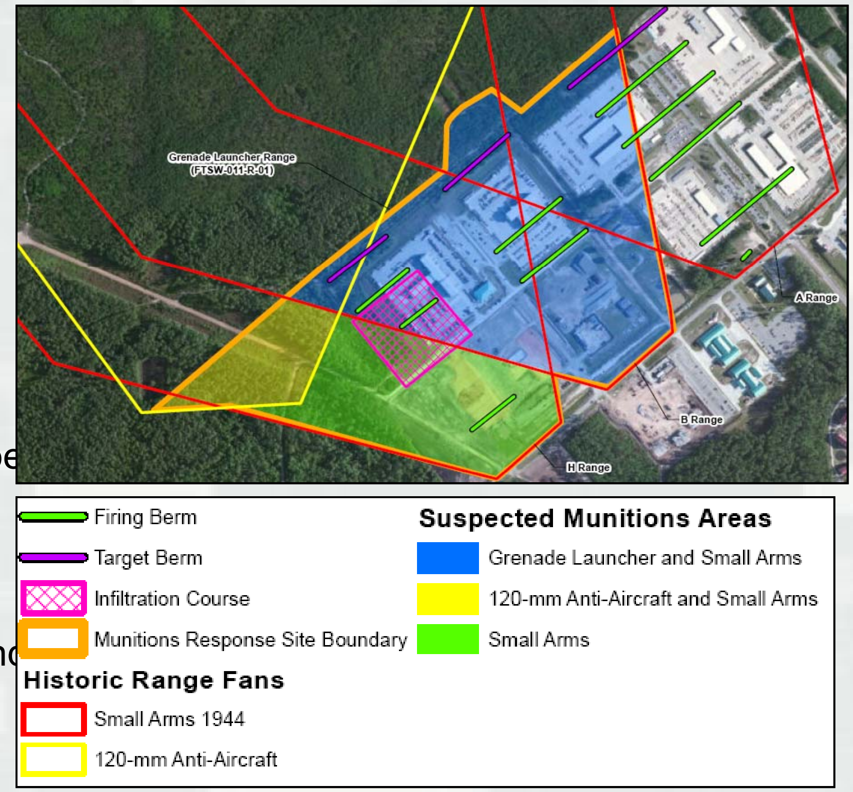
Grenade Launcher Range
Phase 2 Confirmatory Sampling Report



Sample	Pb (mg/kg)
FTSW-SS-18	22.6
FTSW-SS-19	54.8
FTSW-SS-20	61.4
FTSW-SS-21	4.9
FTSW-SS-22	1.9
FTSW-SS-24	58.8
FTSW-SS-25	17.1

Grenade Launcher Range
MEC Conceptual Site Model

- **Source:**
  - The MRS was used as a practice grenade launcher range, infiltration course, 120mm anti-aircraft range, and three small arms ranges during the 1940s.
  - At the Grenade Launcher Range (co-located with B Range), 40mm practice grenades were fired into target berms.
  - The 120mm anti-aircraft range within the MRS represents a small fraction of the range fan. Therefore, targets associated with the range would be in the operational area.
  - Troops may have left DMM close to the firing points.
  - Based on this information, 40mm practice grenades may be present in the surface or subsurface in/around the Range B target berm. DMM may be present in/around the 120mm firing point. Additionally, small arms may be present in the surface and subsurface throughout the MRS.

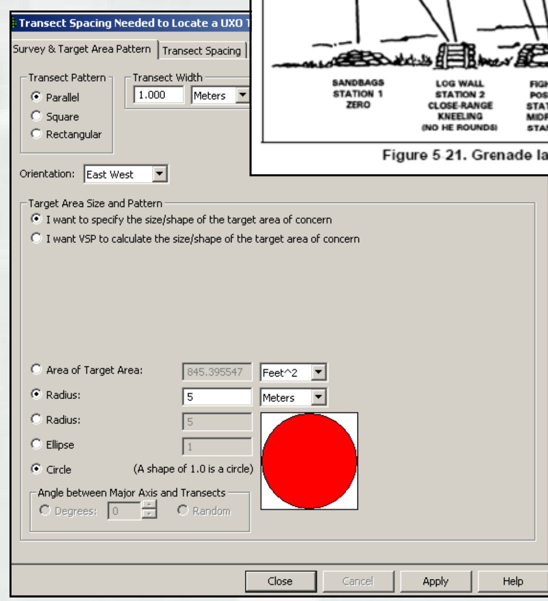


Grenade Launcher Range
MEC Conceptual Site Model

- **Activity:** The MRS is comprised mostly of recently developed cantonment area (non residential).
- **Access:** Access to Fort Stewart is restricted, but there are no access restrictions to most areas once on FTSW property.
- **Receptors:** Installation Personnel, contractors, trespassers, and biota

Grenade Launcher Range
VSP Analysis

- Concentrated areas of MEC/MDAS may be present in/around the Grenade Launcher Range target area.
- Based on a review of Field Manual No. 3-22.31 *40-MM Grenade Launcher, M203*, individual targets are approximately 10 meters in diameter.
- VSP "Transect Sampling for UXO Target Traversal" module with 10 meter diameter target input is proposed to identify any concentrated areas of MEC/MDAS within the Grenade Launcher Range target berm areas.



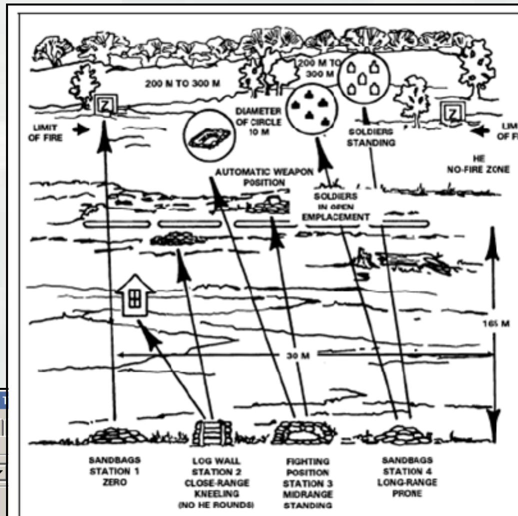


Figure 5 21. Grenade launcher range.

Grenade Launcher Range Data Quality Objectives

1. State the problem.
   - The MRS was used as a practice grenade launcher range, infiltration course, 120mm anti-aircraft range, and small arms ranges during the 1940s. Based on this information, there is a potential for MEC/MDAS (including DMM) in the surface and subsurface. UXO is only anticipated within the Grenade Launcher Range fan. DMM may be present in/around the 120mm firing point.
   - If exposed filler or DMM pits are observed, there is a potential for environmental impacts from MC at the MRS.
2. Identify the decision.
   - What is the nature and extent of MEC (including DMM) and MC?
   - Are there unacceptable MEC hazards or MC risks from previous activities at the MRS?

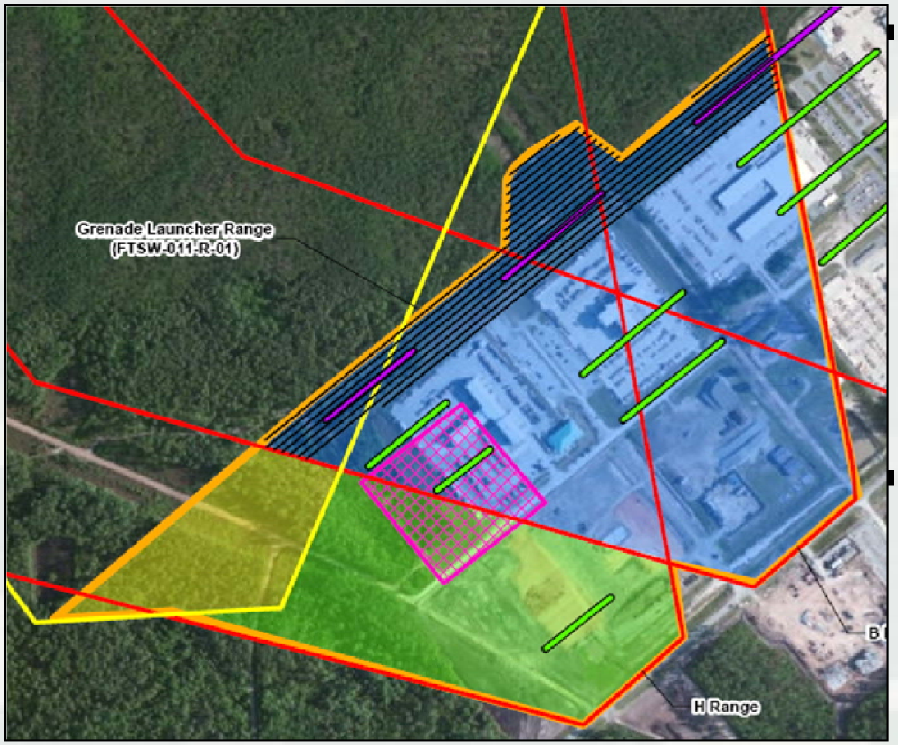
Grenade Launcher Range
Data Quality Objectives

3. Identify inputs to the decisions.
   - ► Historical use of MRS
   - ► Confirmatory Sampling survey and soil sampling data
   - ► RFI Field Activities
     - MEC investigation for subsurface metallic items
     - MEC investigation at firing points where DMM could be present
     - MC sample results (if required)
4. Define study boundary.
   - ► Grenade Launcher Range represents 143 acre MRS that was identified during the Phase 2 CS Report.
   - ► The MRS is bound by the operational range to the north.

Grenade Launcher Range
Data Quality Objectives

5. Develop decision rules.
   - ► If MEC is found
     - Determine the nature and extent of MEC in the area
     - Perform a MEC Hazard Assessment
   - ► If a potential MC release (i.e., exposed filler or DMM pit) is observed
     - Collect MC sample(s) to delineate contamination (if any)
     - Perform a risk assessment, if MC in soil is detected above screening levels
     - Investigate other media, if migration is a concern.
6. Specify tolerable limits on decisions.
   - ► VSP "Transect Sampling for UXO Target Traversal" module with 10 meter diameter target.
   - ► Geophysicists develop criteria to identify potential DMM burial pits from DGM data collected at firing points. Use VSP to determine a statistical percentage to investigate.
   - ► Validation of analytical MC data performed per DoD QSM for data evaluation/risk screening

Grenade Launcher Range
Step 7. Optimizing the Design



- Target Berm Investigation
  - Surface/subsurface investigation around grenade launcher target berm to determine if UXO are present.
  - 4-foot wide mag and dig transects by UXO Technicians, with all anomalies investigated.
- 120 mm Firing Point Investigation
  - DGM survey to determine if anomalies indicative of buried DMM are present.
  - If so, investigate anomalies

Grenade Launcher Range
Step 7. Optimizing the Design

- Munitions Constituents (MC)
  - Based on the findings of the CS Report, unacceptable MC risks are not expected
    - Lead, the most likely MC of concern in a small arms range, was not elevated significantly in 14 soil samples (including 4 from the berms)
    - No explosives were detected
  - Additional MC sampling is not proposed unless exposed fillers or burial pits containing DMM are found.
  - Surface water, sediment, and groundwater sampling is not anticipated to be required unless significant MC concentrations are found in soil

Deliverables and Schedule

- RFI Work Plan

► Technical Project Planning #1	February 2014
► Draft Work Plan to Army	March 2014
► Draft Final Work Plan to GAEPD	May 2014
► Technical Project Planning #2	June 2014
► Final Work Plan	September 2014

- Field Effort
  - ► September-December 2014

- RFI Report

► Draft RFI Report to Army	January 2015
► Draft Final RFI Report to GAEPD	March 2015
► Technical Project Planning #3	May 2015
► Final RFI Report	July 2015

Appendix H
UFP-QAPP

UNIFORM FEDERAL POLICY QUALITY ASSURANCE PROJECT PLAN
(OPTIMIZED UFP-QAPP WORKSHEETS)

FORT STEWART RCRA FACILITY INVESTIGATION
AT
FOUR MILITARY MUNITIONS RESPONSE PROGRAM SITES:

ANTI-AIRCRAFT RANGE - 4A
ANTI-AIRCRAFT RANGE - 4B
ANTI-TANK RANGE 90-MM-2
GRENADE LAUNCHER RANGE

Prepared for:

USACE, BALTIMORE DISTRICT
10 SOUTH HOWARD STREET
BALTIMORE, MD 21201

Prepared by:

CB&I FEDERAL SERVICES LLC
4696 MILLENNIUM DRIVE, SUITE 320
BELCAMP, MD 21017

FINAL DOCUMENT

SEPTEMBER 2015

Preface

CB&I Federal Services LLC (CB&I) has prepared this Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) in response to Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at the following four Munitions Response Sites (MRSs) located at Fort Stewart (FTSW) in Hinesville, Georgia (GA):

- Anti-Aircraft Range - 4A (FTSW-009-R-01)
- Anti-Aircraft Range - 4B (FTSW-009-R-02)
- Anti-Tank Range 90-MM-2 (FTSW-010-R-01)
- Grenade Launcher Range (FTSW-011-R-01)

This work is being conducted by CB&I for the U.S. Army Corps of Engineers (USACE), Baltimore District under a firm-fixed price Performance Based Contract under the Multiple Award Military Munitions Services (MAMMS), Contract W912DR-09-D-0005, Task Order 0005. This UFP-QAPP will apply to all site and laboratory activities performed as part of the aforementioned project in accordance with *RCRA Facility Investigation Work Plan for Four Military Munitions Response Program Sites: Anti-Aircraft Range - 4A, Anti-Aircraft Range - 4B, Anti-Tank Range 90-MM-2, And Grenade Launcher Range at Fort Stewart*, *Final Document* (CB&I, 2015). Specifically, this UFP-QAPP addresses any munitions constituents (MC) sampling that may be required if there are discoveries of munitions and explosives of concern (MEC) with exposed fillers, burial pits containing discarded military munitions (DMM) or contaminated munitions debris, or small arms berms (not previously characterized). Based on previous investigations at similar ranges, unacceptable MC risk is not anticipated. No surface water, sediment, and groundwater sampling is anticipated to be required unless significant MC concentrations are found in soil, which will be discussed with the Army and regulators to agree on an established approach.

This plan is written in accordance with the format specified in the UFP-QAPP (U.S. Department of Defense [DoD], 2005) using the optimized UFP-QAPP worksheet format (DoD, 2012). This UFP-QAPP provides the guidelines for the systematic data collection and analysis associated with the project. All sampling and monitoring will be performed in accordance with the guidelines specified within this site-specific UFP-QAPP. In accordance with the UFP-QAPP guidance (DoD, 2012), this UFP-QAPP includes optimized 37 worksheets that detail various aspects of the environmental investigation process and establish protocols to allow for comparability and defensibility of sampling and analytical data. The UFP-QAPP is based on ANSI/ASQ E-4 Section 6 (Part B) and complies with U.S. Environmental Protection Agency (USEPA) QA/R-5 and QA/G-5. This specific UFP-QAPP (also referred to herein as QAPP) adheres to the program requirements of *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Final Version 5.0* (DoD, 2013).

Table of Contents

QAPP Worksheet (Optimized Format) **Page**

List of Attachments

QAPP Table 1: Crosswalk: UFP-QAPP Workbook To 2106-G-05 QAPP
Page 1 of 2

Optimized UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section		Potential Applicability		EM 200-1-15 Section
				MEC	MC	
1 & 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off	●	●	NA
3 & 5	Project Organization and QAPP Distribution	2.2.3	Distribution List	●	●	2.1; 2.2
		2.2.4	Project Organization and Schedule	●	●	
4, 7 & 8	Personnel Qualifications and Sign-off Sheet	2.2.1	Title, Version, and Approval/Sign-Off	●	●	2.1.4; 6.2.1, 8.2.5.1
		2.2.7	Special Training Requirements and Certification	●	●	
6	Communication Pathways	2.2.4	Project Organization and Schedule	●	●	2.1; 2.2
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data	●	●	2.2
10	Conceptual Site Model	2.2.5	Project Background, Overview, and Intended Use of Data	●	●	2.2.3.1,12.2
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria	●	●	2.2.3.2; 5.3; 9.2; 11.3
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria	●	●	5.3.7; 11.3; Tables 11-3 through 11-6
13	Secondary Data Uses and Limitations	Chapter 3	QAPP Elements For Evaluating Existing Data	●	●	NA
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule	●	●	2.1; 2.2
15	Project Action Limits and Laboratory-Specific Detection / Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria		●	7; 8.2.4.6; 8.2.6.9
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks	●	●	8.2.4; 8.3.2; 8.5; 8.6; 8.7
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks	●	●	8.8
		2.3.2	Sampling Procedures and Requirements	●	●	
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements		●	7.5.4; 7.5.5; 7.5.6; 7.6.9; 7.7.3; 7.8.9
20	Field QC	2.3.5	Quality Control Requirements	●	●	11
21	Field SOPs	2.3.2	Sampling Procedures and Requirements	●	●	4.4.4; 8.8.1-8.8.4
22	Field Equipment Calibration, Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables	●	●	6.7.2; 7
23	Analytical SOPs	2.3.4	Analytical Methods Requirements and Task Description	●	●	7.5.4; 7.5.5; 7.5.6; 7.6.9; 7.7.3; 7.8.9
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables	●	●	7
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables	●	●	NA

QAPP Table 1: Crosswalk: UFP-QAPP Workbook To 2106-G-05 QAPP
Page 2 of 2

Optimized UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section		Potential Applicability		EM 200-1-15 Section
				MEC	MC	
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation		●	NA
28	Analytical Quality Control and Corrective Action	2.3.5	Quality Control Requirements	●	●	11
29	Project Documents and Records	2.2.8	Documentation and Records Requirements	●	●	13
31, 32 & 33	Assessments and Corrective Action	2.4	Assessments And Data Review (Check)	●	●	4.3, Appendix B
		2.5.5	Reports to Management	●	●	
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods	●	●	8.2.4.7; 8.8.8
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods	●	●	8.2.4.7; 8.8.8
36	Data Validation Procedures	2.5.1	Data Verification and Validation Targets and Methods	●	●	8.8.8
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability	●	●	8.8.8
		2.5.3	Potential Limitations on Data Interpretation	●	●	
		2.5.4	Reconciliation with Project Requirements	●	●	

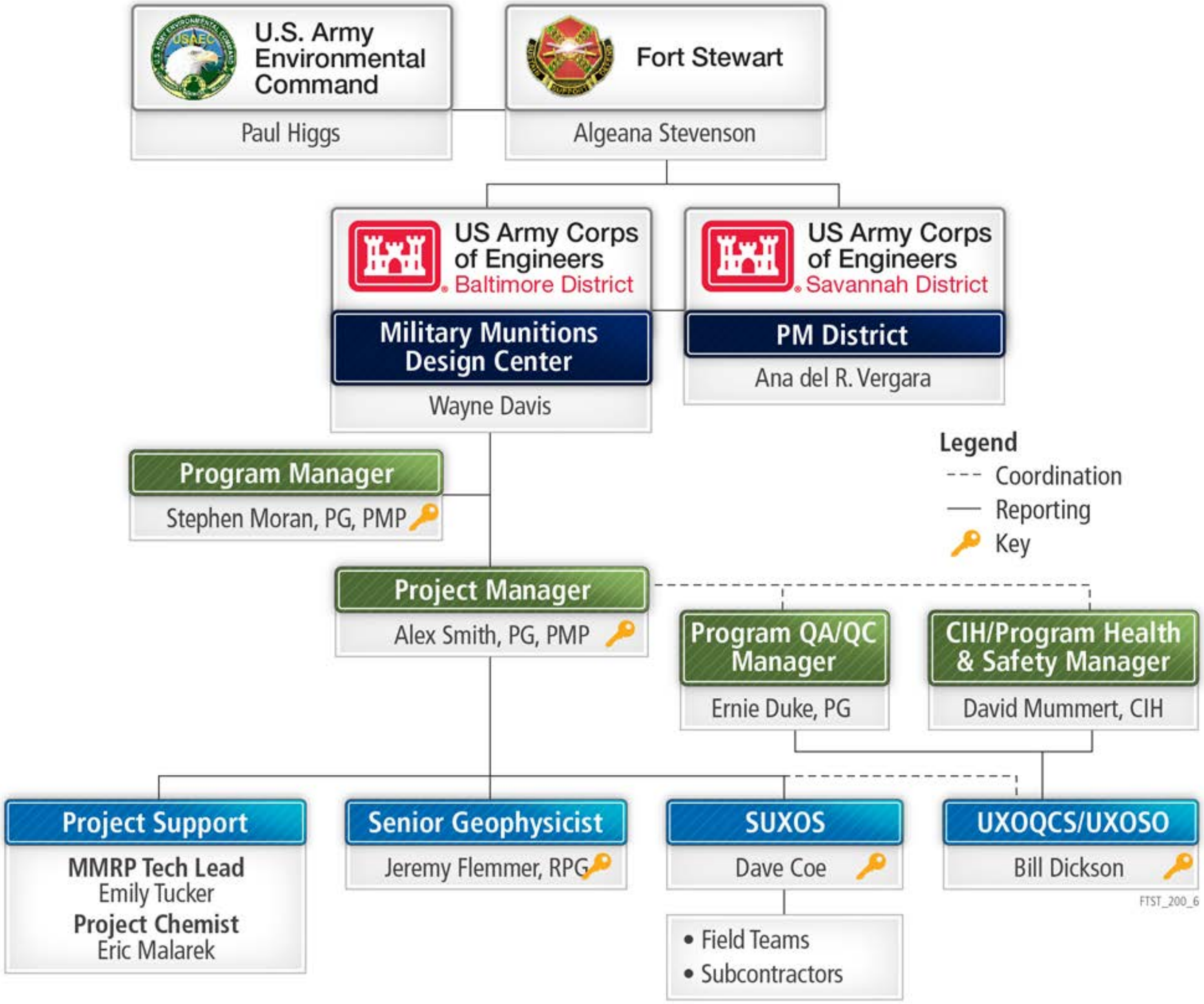
QAPP Worksheets #1 & 2: Title and Approval Page
(UFP-QAPP Manual Section 2.1) (EPA 2106-G-05 Section 2.2.1)

Project Identifying Information:	
Site Name/Project Name:	Fort Stewart
Site Location/Number:	Sites: FTSW-009-R-01: Anti-Aircraft Range 4A; FTSW-009-R-02: Anti-Aircraft Range 4B; FTSW-010-R-01: Anti-Tank Range 90-MM-2; and FTSW-011-R-01: Grenade Launcher Range. Project Number: 500064
Contract/Work Assignment Number:	Contract No. W912DR-09-D-0005, Task Order 0005 – Performance Based Contract

Authority Signature Table (Approval or Oversight):				
Lead Federal Organization	**Name**	**Title**	**Signature**	**Date**
USACE	Ana del Vergara	Project Manager (PM)		
Federal Agency Organizations	**Name**	**Title**	**Signature**	**Date**
Fort Stewart	Algeana Stevenson	Remediation PM		
U.S. Army Environmental Command (USAEC)	Paul Higgs	PM		
State Agency Organization	**Name**	**Title**	**Signature**	**Date**
Georgia Environmental Protection Division (EPD)	Amy Potter	Remediation PM		
Primary Contractor	**Name**	**Title**	**Signature**	**Date**
CB&I	Alex Smith	PM		
CB&I	Eric Malarek	Project Chemist		

QAPP Worksheets #1 & 2: Title and Approval Page
(UFP-QAPP Manual Section 2.1) (EPA 2106-G-05 Section 2.2.1)

List plans and reports from previous investigations relevant to this project:
2003, Closed, Transferring, and Transferred Range/Site Inventory Report
2006, Historical Records Review
2007, Confirmatory Sampling Report
2010, Phase 2 Historical Records Review
2011, MEC Quality Assurance (QA) Investigation to Depth of Detection at Anti-Aircraft Range - 4 MRS (FTSW-009-R-01)
2011, MEC Quality Assurance (QA) Follow-on Investigation to Depth of Detection at Anti-Aircraft Range - 4 MRS (FTSW-009-R-01)
2011, Army and Air Force Exchange Service Shoppette Highway 144 Construction Site at Anti-Aircraft Range - 4 MRS (FTSW-009-R-01)
2011, Engineer BUILDING STRONG® TCRA 10th Battalion Site & Dog Kennel Site
2012, Phase 2 Confirmatory Sampling Report


U.S. Army Environmental Command
Paul Higgs
Fort Stewart
Algeana Stevenson
US Army Corps of Engineers Baltimore District
Military Munitions Design Center
Wayne Davis
US Army Corps of Engineers Savannah District
PM District
Ana del R. Vergara
Legend
Coordination
Reporting
Key
Program Manager
Stephen Moran, PG, PMP
Project Manager
Alex Smith, PG, PMP
Program QA/QC Manager
Ernie Duke, PG
CIH/Program Health & Safety Manager
David Mummert, CIH
Project Support
MMRP Tech Lead
Emily Tucker
Project Chemist
Eric Malarek
Senior Geophysicist
Jeremy Flemmer, RPG
SUXOS
Dave Coe
Field Teams
Subcontractors
UXOQCS/UXOSO
Bill Dickson
FTST_200_6

QAPP Worksheets #4, 7 & 8: Personnel Qualifications and Sign-off Sheet
(UFP-QAPP Manual Sections 2.3.2 – 2.3.4) (EPA 2106-G-05 Sections 2.2.1 and 2.2.7)

LEAD ORGANIZATION: USACE				
Name	**Project Title/Role**	**Education/Experience**	**Specialized Training/Certifications**	**Signature/Date[1]**
Ana del Vergara	PM	As specified by USACE requirements	None	Electronic Receipt
Sal Van Wert	Technical Lead	As specified by USACE requirements	None	Electronic Receipt
Tom Colozza	Project Geophysicist	As specified by USACE requirements	None	Electronic Receipt
Deborah McKinley	Engineer	As specified by USACE requirements	None	Electronic Receipt

ORGANIZATION: CB&I				
Name	**Project Title/Role**	**Education/Experience**	**Specialized Training/Certifications**	**Signature/Date[1]**
Alexander Smith	PM	B.S. Geology, 18 years experience	PMP	Electronic Receipt
Emily Tucker	MMRP Technical Lead	B.S. Environmental Biology, 4 years experience	• 40-Hour Hazardous Waste Site Worker (All Field Staff) • 8-Hour Hazardous Waste Site Worker Annual Refresher (All Field Staff) • 8-Hour Hazardous Waste Site Supervisor Training (MC Sampling Lead Only) • 50-Hour Site Safety Officer Training including 10-Hour OSHA Construction Site Worker Safety Training (Site H&S Officer Only) • Meet all requirements as specified in the DDESB Technical Paper (TP) 18 Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel (DDESB, 2004, Table 4-1) (UXOQCS, UXOSO, and SUXOS Only)	Electronic Receipt
Bill Dickson	UXOQCS and UXOSO	Explosvie Ordnance Disposal (EOD) Training, 36 years experience		Electronic Receipt
David Coe	SUXOS	EOD Training, 37 years experience		Electronic Receipt
David Mummert	Certified Industrial Hygienist	Certified Industrial Hygienist, 25 years experience		Electronic Receipt
Emily Tucker	MC Sampling Lead	B.S. Environmental Biology, 4 years experience		Electronic Receipt
Bill Dickson	Site Health and Safety (H&S) Officer	EOD Training, 36 years experience		Electronic Receipt
Jeremy Flemmer	Project Geophysicist	B.S. Applied Earth Sciences Geophysics, 29 years experience		Electronic Receipt
Eric Malarek	Project Chemist	B.A. Chemistry; Master Business Admin., 26 years experience		Electronic Receipt
Paul Goetchius	Human Health Risk Assessor	PhD. Veterinary Medicine, B.S., Animal Science 39 years experience	None	Electronic Receipt
Mark Weisberg	Ecological Risk Assessor	B.S. Biology and Environmental Studies; M.S., Oceanography and Limnology, M.S., Water Resources Management 30 years experience	Certified Hazardous Materials Manager	Electronic Receipt

QAPP Worksheets #4, 7 & 8: Personnel Qualifications and Sign-off Sheet
(UFP-QAPP Manual Sections 2.3.2 – 2.3.4) (EPA 2106-G-05 Sections 2.2.1 and 2.2.7)

ORGANIZATION: Fort Stewart				
Name	**Project Title/Role**	**Education/Experience**	**Specialized Training/Certifications**	**Signature/Date[1]**
Algeana Stevenson	Remediation PM	As specified by Army requirements.	None	Electronic Receipt

ORGANIZATION: Georgia EPD				
Name	**Project Title/Role**	**Education/Experience**	**Specialized Training/Certifications**	**Signature/Date[1]**
Amy Potter	Remediation PM	As specified by Georgia Environmental Protection requirements.	None	Electronic Receipt

ORGANIZATION: USAEC				
Name	**Project Title/Role**	**Education/Experience**	**Specialized Training/Certifications**	**Signature/Date[1]**
Paul Higgs	USAEC PM	As specified by USAEC requirements.	None	Electronic Receipt

ORGANIZATION: CT Laboratories, Inc.				
Name	**Project Title/Role**	**Education/Experience**	**Specialized Training/Certifications**	**Signature/Date[1]**
David A Berwanger	Laboratory Director	B.S. Chemistry, >30 years experience.	None	Electronic Receipt
Eric T Korthals	Laboratory PM	M.S. Chemistry, B.S. Biology, >30 years experience.	None	Electronic Receipt
Christelle Newsome	Laboratory Quality Assurance Officer (QAO)	B.S. Chemistry, >30 years experience.	None	Electronic Receipt

[1] Signatures of Authority Approvers and Oversight on Worksheets #1 and #2 indicate agency and primary contractor have read and agree to the implementation of this UFP-QAPP as written. All other project members and/or subcontractors associated with the Authority Approvers and Oversight will follow set requirements outlined here-in.

QAPP Worksheet #6: Communication Pathways
(UFP-QAPP Manual Section 2.4.2) (EPA 2106-G-05 Section 2.2.4)

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Point of Contact with Regulators	USACE PM	Ana del Vergara	(912) 652-5835 Anadel.R.Vergara@sas02.usace.army.mil	All materials, communications, and information pertaining to the project must be approved by FTSW and USACE prior to distribution to the regulators.
	FTSW Remediation PM	Algeana Stevenson	(912) 315-5144 Algeana.stevenson@us.army.mil	
Manage All Project Phases	CB&I PM	Alex Smith	(410) 273-7313 alexander.smith@cbifederalservices.com	Issues are to be reported to the USACE PM immediately and followed up in writing within 2 business days.
Technical Approach to Project Activities	CB&I Technical Lead	Emily Tucker	(410) 273-7330 emily.tucker@cbifederalservices.com	CB&I Technical Lead will provide oversight to the CB&I PM via phone, fax, or e-mail.
Changes in the Field	CB&I MC Sampling Lead	Emily Tucker	(410) 273-7330 emily.tucker@cbifederalservices.com	CB&I MC Sampling Lead will provide daily reports to the CB&I PM via phone, fax, or e-mail.
Daily Field Progress Reports	All CB&I employees and subcontractors have stop work authority related to safety or quality issues	Alex Smith	(410) 273-7313 alexander.smith@cbifederalservices.com	All stop work requests are reported immediately to the CB&I PM or designee. Safety issues are also reported directly to the CB&I H&S lead or designee, quality issues related to sampling or analysis are reported to the CB&I Project Chemist, and other quality issues are reported to the CB&I QA Manager.
Reporting Laboratory Data Quality Issues and Lab Analytical Corrective Actions	CT Laboratories, Inc. QAO	Christelle Newsome	(608) 356-2760 cnewsome@ctlaboratories.com	All quality assurance/quality control (QA/QC) issues with laboratory analyses will be reported to the CB&I Project Chemist immediately and corrective actions implemented. The corrective actions follow-on report will be provided to the CB&I PM within 2 business days.

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Field Corrective Actions	CB&I MC Sampling Lead	Emily Tucker	(410) 273-7330 emily.tucker@cbifederalservices.com	The need for corrective action for field issues will be reported by the MC Sampling Lead and documented in a technical directive within 2 business days.
Data Verification and Release of Analytical Data	CB&I Project Chemist	Eric Malarek	(410) 273-7233 eric.malarek@cbifederalservices.com	No analytical data will be released until verification is completed. Data will be verified by the CB&I Project Chemist within one business day of receipt from the laboratory.
UFP-QAPP Amendments	CB&I Project Chemist	Eric Malarek	(410) 273-7233 eric.malarek@cbifederalservices.com	Any major changes to the QAPP must be approved by the CB&I PM and the USACE PM before the changes can be forwarded to field team. The proposed changes will be forwarded to the field team within 5 days of proposal. Changes to the QAPP will not be implemented unless approved.
Data Requests and Reporting	CB&I Project Chemist	Eric Malarek	(410) 273-7233 eric.malarek@cbifederalservices.com	All requests for data are directed to the CB&I Project Chemist. The CB&I Project Chemist reviews data prior to release.
Data Reporting – Electronic Deliverable	CB&I Project Chemist	Eric Malarek	(410) 273-7233 eric.malarek@cbifederalservices.com	The Project Chemist ensures that electronic deliverable submittals are prepared and submitted on a regular basis.

QAPP Worksheet #6: Communication Pathways
(UFP-QAPP Manual Section 2.4.2) (EPA 2106-G-05 Section 2.2.4)

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Database Issues	CB&I Data Manager	Randy Dameron	(865) 694-7342 randy.dameron@cbifederalservices.com	All issues relating to operation or maintenance of the database are directed to the Project Chemist, including requests for access and special reporting formats.

QAPP Worksheet #9: Project Planning Session Summary
(UFP-QAPP Manual Section 2.5.1 and Figures 9-12) (EPA 2106-G-05 Section 2.2.5)

Date of planning session:	February 26, 2014		
Location:	Georgia Environmental Protection Division, Atlanta, GA		
Purpose:	Technical Project Planning (TPP) Meeting		
Participants:			
Name	**Organization**	**Title/Role**	**Phone/Email**
William Powell	Georgia EPD	Environmental Engineer	(404) 657-8680 william.powell@dnr.state.ga.us
Amy Potter	Georgia EPD	Remediation PM	(404) 657-8604 amy.potter@dnr.state.ga.us
Mo Ghazi	Georgia EPD	Geologist	(404) 657-8668 mo.ghazi@dnr.state.ga.us
Ana Vergara	USACE – Savannah	Project Manager	(912) 652-5835 ana.delr.vergara@usace.army.mil
Zsolt Haverland	USACE – Savannah	Geologist	(912) 652-5815 zsolt.haverland@usace.army.mil
Maria Orosz	USACE – Baltimore	Technical Lead	(410) 962-2700 maria.t.orosz@usace.army.mil
Tom Colozza	USACE – Baltimore	Geophysicist	(410) 962-6647 thomas.s.colozza@usace.army.mil
Debbie McKinley	USACE – Baltimore	Environmental Engineer	(410) 962-6730 deborah.k.mckinley@usace.army.mil
Algeana Stevenson	FTSW	Remediation PM	(912) 315-5144 algeana.l.stevenson.civ@mail.mil
Paul Higgs	U.S. Army Environmental Command	USAEC PM	(210) 466-1727 Paul.a.higgs@us.army.mil
Alex Smith	CB&I	CB&I PM	(240) 586-1341 alexander.smith@cbifederalservices.com
Laura O'Donnell	CB&I	Project Engineer	(410) 273-7242 laura.odonnell@cbifederalservices.com
Emily Tucker	CB&I	Project Scientist	(410) 273-7330 emily.tucker@cbifederalservices.com

Notes/Comments:			
Consensus Decisions Made:	The presentation provided a brief overview of the TPP process including the four phases: 1) Identification of current project area, 2) Determination of data needs, 3) Development of data collection options, and 4) Finalization of the data collection program. See TPP Memo dated April 29, 2014, for further details.		
Action Items:			

Action	**Responsible Party**	**Due Date**
Algeana Stevenson to speak with the FTSW wetlands group about investigating the wetlands areas.	Algeana Stevenson	Not Specified
CB&I will review historical aerial photos of the ranges to ensure that target areas and firing points are understood, especially at the Grenade Launcher Range.	Alex Smith	Not Specified
CB&I will develop a work plan incorporating the information presented and results of discussions.	Alex Smith	Not Specified

Conceptual Site Model (CSM)

The CSM compiles all known information into an illustration of exposure pathways. The Ordnance and Explosives CSM document (USACE, 2003) divides the analysis into four components: source, activity, access, and receptor. Each component is briefly discussed in the following sections.

Source:

A preliminary assessment of potential source areas is provided by the Historical Records Review, USACE, Baltimore District investigations, TCRAs, and Phase 2 Confirmatory Sampling (CS).

<u>Anti-Aircraft Range - 4A and 4-B</u>

The Anti-Aircraft Range - 4A consists of 465 acres where MEC investigations and removals were performed by USACE, Baltimore District. The Anti-Aircraft Range - 4B represents the 663 acres that remain undeveloped and largely uninvestigated.

The Anti-Aircraft Range - 4A and 4B together represent the firing points and vicinity for three overlapping 40mm and 90mm anti-aircraft ranges that fired to the north, extending well beyond the MRSs into the Operational Range of FTSW. Activities associated with the anti-aircraft range training took place from 1941 to 1964. During range activities, M2 target rockets served as aerial targets for anti-aircraft gunners. The M2 target rocket, which simulated low-flying high-speed aircraft, was fired from a mobile launcher with a solid propellant. These rockets did not contain explosives and had a maximum range of approximately 1 mile. In addition to range activities, troops may have also buried DMM (M2 target rockets, 90mm projectiles, and 40mm projectiles) close to the firing points during training exercises. A summary of fillers that may have been used on this range is as follows.

Munition	Type	Filler	Reference
40mm, AA, HE-P, MK3	Projectile	TNT	ORDATA Online
90mm, HE, M71 / HE-T, M71A1	Projectile	TNT, Comp B (RDX and TNT)	Army Technical Manual TM 9-1300-251-20
90mm, AP M318 / M318 (T33E7) / M318A1	Projectile	Solid Steel Slug	Army Technical Manual TM 9-1300-251-20

During the Phase 2 CS, four discrete surface soil samples analyzed for select metals and explosives at randomly distributed locations. Metals were detected well below USEPA Regional Screening Levels (RSLs) and Region 4 Ecological Screening Values (ESVs). No explosives were detected above method detection or laboratory reporting limits.

Based on the Phase 2 CS findings, there is no known source of MC at the Anti-Aircraft Range - 4A and 4-B. However, a potential MC release may be present if exposed filler, a DMM pit, or small arms berm is observed during the MEC investigation.

<u>Anti-Tank Range 90-MM-2</u>

The Anti-Tank Range 90-MM-2 is a 546-acre MRS. The eastern portion of the MRS was historically used for firing 40mm anti-aircraft and 90mm anti-tank rounds from what is now covered with a motor pool and fueling station. These range fans extended well beyond the MRS into the Operational Range of FTSW. The western portion of the MRS partially overlaps small arms, grenade launcher, and 120mm anti-aircraft range fans that fired from slightly south of the MRS. The large areal extent and layout of the range fans and the relatively small size of the MRS near the firing points suggest that target areas associated with 40mm, 90mm, and 120mm projectiles are not anticipated. Troops may have also buried DMM close to the firing points during training exercises. A summary of fillers that may have been used on this range is as follows.

Munition	Type	Filler	Reference
40mm, AA, HE-P, MK3	Projectile	TNT	ORDATA Online
90mm, HE, M71 / HE-T, M71A1	Projectile	TNT, Comp B (RDX and TNT)	Army Technical Manual TM 9-1300-251-20
90mm, AP M318 / M318 (T33E7) / M318A1	Projectile	Solid Steel Slug	Army Technical Manual TM 9-1300-251-20
120mm, HE, AA, M173	Projectile	TNT	ORDATA Online

During the Phase 2 CS, four surface soil samples analyzed for select metals and explosives (two collected from suspected firing lines). Zinc was detected above the FTSW background and USEPA Region 4 ESV, but below the USEPA RSL, in one sample (SS-06). Lead was detected above the FTSW background, but below the USEPA RSLs or USEPA Region 4 ESVs, in one sample (SS-06). All other metals (aluminum, antimony, and copper) were detected below the USEPA RSLs and Region 4 ESVs. No explosives were detected above method detection or laboratory reporting limits.

Based on the Phase 2 CS findings, there is no known source of MC at the Anti-Tank Range 90-MM-2. However, a potential MC release may be present if exposed filler, a DMM pit, or small arms berm is observed during the MEC investigation.

Grenade Launcher Range

The Grenade Launcher Range MRS was used for anti-aircraft, anti-tank, grenade launcher, and small arms training during the 1940s. Three small arms ranges (H, B, and A) are located within the MRS, which consisted of numerous firing mounds. Range B was also used to fire 40mm practice grenades with grenade launchers. A 9.2-acre infiltration course is located within Range H, which included .30-cal machine gun firing and detonations of one pound blocks of trinitrotoluene (TNT) to simulate battle conditions. A firing point for 120mm anti-aircraft projectiles was also located on the western portion of the MRS. UXO is only anticipated within the Grenade Launcher Range fan. DMM may be present in/around the 120mm firing point. These areas have the potential to contain MEC/Material Documented as Safe (MDAS) in the surface and subsurface. The remainder of the MRS was used for small arms training. As such, MEC/MDAS is not anticipated in those areas.

A summary of fillers that may have been used on this range is as follows.

Munition	Type	Filler	Reference
40mm, Practice, M781	Projectile	Orange Dye Powder	ORDATA Online / MIDAS
40mm Grenade, M430, M383, M384, M677	Projectile	Comp A5 (RDX w/1.5% stearic acid)	ORDATA Online
120mm, HE, AA, M173	Projectile	TNT	ORDATA Online

During the Phase 2 CS, 14 discrete surface soil samples collected and analyzed for select metals and explosives. Lead was detected at a maximum concentration of 61.4 milligrams per kilogram (mg/kg). None of the samples collected exceeded the USEPA RSL for lead. Three of the samples exceeded the ESV. Nine samples exceeded the FTSW background. All other metals (aluminum, antimony, copper, and zinc) were detected below the USEPA RSLs or the USEPA Region 4 ESV. No explosives were detected above laboratory detection or method reporting limits. Lead, the most likely MC of concern in a small arms range, was not elevated significantly in 14 soil samples (including 4 from the berms).

Based on the Phase 2 CS findings, there is no known source of MC at the Grenade Launcher Range. However, a potential MC release may be present if exposed filler or a DMM pit is observed during the MEC investigation.

Activity:
Activity describes ways that a receptor comes in contact with a source. A large portion of FTSW consists of undeveloped, forested land and wetlands. The majority of FTSW is considered operational area. The current and projected future land use for each MRS is discussed below.

Anti-Aircraft Range - 4A

The Anti-Aircraft Range - 4A consists of recently developed residential and industrial areas. Facilities located within the MRS include: barracks, operations facilities, tactical equipment maintenance facilities, Brigade/Battalion Headquarters facility, dining facility, a physical fitness center, and family care clinic. No changes in the land use are anticipated or planned.

Anti-Aircraft Range - 4B

The Anti-Aircraft Range - 4B is mostly undeveloped, forested land. The southern portion of the MRS is a non-residential portion of the cantonment area with a horse stable and maintenance facility. No changes in the land use are anticipated or planned within the Anti-Aircraft Range - 4B.

Anti-Tank Range 90-MM-2

The majority of the Anti-Tank Range 90-MM-2 consists of forested areas and grasslands. The MRS is also partially comprised of the non-residential cantonment area and a borrow area. No changes in the land use are anticipated or planned within the Anti-Tank Range 90-MM-2.

Grenade Launcher Range

The majority of the Grenade Launcher Range consists of the recently developed, non-residential portion of the cantonment area. The western portion of the MRS consists of undeveloped, forested land. No changes in the land use are anticipated or planned within the Grenade Launcher Range.

Access:
FTSW is readily accessible via multiple roads. Once access to FTSW property has been obtained, there are no further restrictions to access any of the sites.

Receptors:
Receptors at FTSW include residents, authorized installation personnel, visitors, and trespassers. In addition, wildlife could be affected including rare, threatened, or endangered species.

Components of Project-Specific Data Quality Objectives (DQOs):		
DQO Elements		**Definition**
Problem Statement	Problem and Objectives	Describes the activity objectives and problem of focus associated with the scope of work
Decision Identification	Decision Statement	Describes the decision statement that the study will attempt to resolve
	Alternative Actions	Describes the alternative actions to the decision statement
Decision Inputs	Chemicals of Interest	Defines the chemical analytical parameters to be conducted
	Physical Data	Defines the physical analytical parameters or measurements to be conducted
	Sampling Method	Defines the type of sampling method to be used
	Analytical Method	Specifies the USEPA methodology for chemical and physical analyses
	Detection Limits (DLs), LODs, LOQs	Specifies the sensitivities for the chemical analyses
	Field Quality Control Samples	Provides the field QC samples to be performed
	Data Use	Provides the data's end use
	Validation Level	Defines the USEPA validation level to be performed
Study Boundary	Action Levels	Provides the levels of concern
	Sample Media	Specifies media to be sampled
	Spatial and temporal boundaries	Provides the spatial and population characteristics
	Timeframe	Specifies project timeline
	Practical Constraints	Specifies sample collection constraints
	Scale	Provides scale of project activities
Decision Rule Development	Decision Rule	Defines the compounds of concern and action levels for which decisions are to be made
Tolerance Limits on Decision Errors	Acceptable Tolerance Limits	Specifies the decision maker's tolerable limits on decision errors
Design Optimization	Sampling Design	Specifies the optimal design for collection of data

<table>
<tr><th colspan="2">DQO Elements</th><th>DQO Output</th></tr>
<tr><th colspan="2"></th><th>RFI</th></tr>
<tr><td>1. State The Problem</td><td>Problem Statement</td><td>The MRSs included in this work plan served as firing points for anti-aircraft and anti-tank ranges. Additionally, the Grenade Launcher Range MRS served as an infiltration course, grenade launcher range, and small arms range. As stated in Worksheet #10, there are no known sources of MC at any of the MRSs based on Phase 2 CS sampling. However, a potential MC release could be encountered during the RFI MEC investigation if exposed fillers, a DMM pit, or previously unknown small arms berm is discovered.

It should be noted that additional field investigations at Anti-Aircraft Range - 4A will not be conducted as sufficient coverage has been obtained during previous investigations.</td></tr>
<tr><td rowspan="2">2. Identify The Decision</td><td>Decision Statement</td><td>If a DMM pit or other potential MC release is identified during the RFI for MEC, assess and delineate the nature and extent of MC in soil, sediment, and surface water and determine if there is unacceptable risk to human health or the environment.</td></tr>
<tr><td>Alternative Actions</td><td>If no potential sources of MC are discovered during the MEC investigation as described in the work plan, then no further MC soil sampling is necessary and conclude that MC does not pose an unacceptable risk to human health and the environment.

If a potential MC source is discovered during the MEC investigation (i.e., exposed fillers, DMM pit, uncharacterized small arms berm), then collect soil samples to determine if MC are present above screening levels.

• If MC are present above screening levels in soil, sediment, or surface water then determine the nature and extent of MC contamination and assess the risk to human health and the environment.

• If unacceptable risk is calculated, then evaluate corrective measures in a Corrective Measures Study (CMS).</td></tr>
<tr><td>3. Identify The Inputs To The Decision</td><td>Chemicals Of Interest</td><td>Known munitions at the MRSs include 40mm, 90mm, and 120mm projectiles, M2 target rockets, 81mm practice mortars, M67 hand grenades, 40mm practice grenades, 2.75” and 3.5” rockets, and M16A1 anti-personnel mines. These items may have contained a variety of explosive fillers such as TNT, RDX, and associated breakdown products.

The casings for these items are predominantly steel which does not pose a release concern. Metals of concern for munitions include antimony, copper, lead, and zinc, which is usually the result of a concentration of small arms bullets. Other metals of interest are aluminum, calcium, iron, magnesium, and manganese, as they can be used for geochemical evaluations to determine if detected concentrations in soil represent natural ratios. TOC and pH are also of interest to assess mobility/absorption for risk evaluations.</td></tr>
</table>

DQO Elements		**DQO Output** **RFI**
3. Identify The Inputs To The Decision (continued)	Chemicals Of Interest	MC chemicals of interest will be based on the munitions found that prompted sampling. It is uncertain what will be encountered during MEC investigations and what amount of sampling will be needed, if any, to complete the RFI. Based on experience at other firing ranges, MC contamination is seldom a problem except for metals where small arms bullets accumulate. The sampling design described here-in is limited in scope to preliminarily assessing a potential release of MC in the event exposed fillers or an accumulation of buried DMM or MDAS is encountered. This will include a phased approach of a) biased, discrete sampling to determine if MC are present above background and health-based screening levels, followed by b) delineation in soil, if screening levels are exceeded, to establish the horizontal and vertical extent. If the MC contamination is more extensive or justifies sampling of other media, then the findings and proposed approach to further characterization will be provided to the USACE and GAEPD for concurrence in the form of a memorandum. In the event that individual munitions with exposed fillers are found, then two discrete soil samples will be collected to assess the potential point source release: one directly beneath the item(s) and one from a depth of 1 foot below the item(s) to determine if MC has migrated. Random sampling and incremental sampling methodology would be more appropriate for widespread contamination, which is not anticipated at this time. If these results exceed background and health-based screening levels, then additional delineation and additional media sampling may need to be performed, which will consist of step out samples in the horizontal and vertical direction, as needed to bind the contamination. The spacing of step out samples will generally be 2 feet, but may be greater or lesser depending on best professional judgment in consideration of the anticipated areal extent of the release and the concentrations observed. The ProUCL Users Guidance for ecological risk assessment recommends at least eight sample results to be used for the 95% UCL EPC calculations. For small, localized sources of MC contamination, fewer than eight samples is acceptable, and the maximum detected concentration of each analyte will be used in the risk screening and risk assessment. Locations of MC samples will be recorded using a handheld GPS and staked/flagged until analytical results are available and it is determined whether additional step out sampling is needed.
	Physical Data	Map locations for all sample locations will be generated.

<table>
<tr><th colspan="2">DQO Elements</th><th>DQO Output</th></tr>
<tr><th colspan="2"></th><th>RFI</th></tr>
<tr><td rowspan="3">3. Identify The Inputs To The Decision (continued)</td><td>Sampling Method</td><td>Direct grab sampling – Disposable Trowel or Spoon. See Worksheet #21 and Attachment 1 for SOP.

Discrete samples will be collected using hand tools, such as either disposable or dedicated trowel and spoon. Where possible, disposable or dedicated equipment will be used eliminating the need for rinse blanks. The surface soil samples will be collected from 0.0 to 0.5 foot bgs. Subsurface soil samples (if needed) will be collected from 0.5 to 1.5 feet bgs.

Samples from DMM pits will be collected from the side walls, the pit floor, and 2 feet below the bottom of the pit floor. See Worksheet #17.

Sample material will be placed in a clean container and homogenized (per SOPs EI-FS-101 and EI-FS-010, provided in Attachment 1) prior to placing the sample into sample containers. Vegetative matter and rocks will be removed from the sample. Any metallic debris (including bullet fragments or fragments from MD) will be removed by hand, and notations made on the sample collection sheet.</td></tr>
<tr><td>Analytical Methods</td><td><u>MC Sampling (Matrix = Soil; Frequency = As needed; Period = September to December 2014)</u>:
• MC and Geochemical Metals, USEPA Method SW-846 6010C Modified: Aluminum, Antimony, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, and Zinc.
• Lead, USEPA Method SW-846 6010C Modified.
• Explosives, USEPA Method SW-846 8330A Modified: octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), 1,3,5-trinitrobenzene (TNB), 1,3-dinitrobenzene (DNB), Tetryl, nitrobenzene (NB), 2,4,6-TNT, 4-Am-dinitrotoluene (DNT), 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2-nitrotoluene (NT), 3-NT, 4-NT, nitroglycerin (NG), and pentaerythritol tetranitrate (PETN).

<u>Soil Representativeness Analysis</u>:
• TOC, USEPA Method Lloyd Kahn
• pH, USEPA Method SW-846 9045D

<u>Method modifications</u>: The preparation laboratory procedures for soils for metals by 6010C Mod and explosives 8330A Mod analysis will include sieving with a #10 sieve prior to digestion or extraction step. The total weight of the sample, the weight of retained material, and/or the munitions debris (MD) should be reported, as applicable. The sample should be qualitatively described and photos may be taken, if necessary, of the contained and retained material (e.g., gravel, twigs, shot, skeet fragments). If necessary for breaking up hard clumps (e.g., dried clay), the samples should be dried and ground. In addition, the explosives 8330A Mod target list will include PETN and NG.</td></tr>
<tr><td>DLs, LODs, LOQs</td><td>Refer to Worksheets #15.1 and #15.2 for metals, Worksheets #15.3 and #15.4 for explosives, and Worksheets #15.5 and #15.6 for TOC and pH.</td></tr>
</table>

<table>
<tr><th colspan="2">DQO Elements</th><th>DQO Output</th></tr>
<tr><th colspan="2"></th><th>RFI</th></tr>
<tr><td rowspan="3">3. Identify The Inputs To The Decision (continued)</td><td>Field Quality Control Samples</td><td>Rinse Blank (5% frequency per matrix per sampling technique) (Not required if dedicated or disposable equipment is used)
Field Duplicate (10% frequency per matrix)</td></tr>
<tr><td>Data Use</td><td>Nature and Extent, Geochemical Evaluation, Risk Assessment</td></tr>
<tr><td>Validation Data Level</td><td>Data Verification for all field samples and full Data Validation for MC Samples – See Worksheets #34 and #36</td></tr>
<tr><td rowspan="6">4. Define The Boundaries Of The Study</td><td>Action Levels</td><td>USEPA Regional Screening Level Summary Table, Residential Soil, June 2015; Hazard Index = 0.1. Refer to Worksheets #15.1 and #15.2 for metals, Worksheets #15.3 and #15.4 for explosives, and Worksheets #15.5 and #15.6 for TOC and pH.

Background Values (for metals) based on Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia, Volume I of III (2000). Refer to Worksheet #13.</td></tr>
<tr><td>Media To Sample</td><td>Soil</td></tr>
<tr><td>Spatial Boundaries</td><td>The RFI will be performed in the boundaries as defined from the Phase 2 CS to include FTSW Area MMRP MRS sites: FTSW-009-R-01: Anti-Aircraft Range 4A; FTSW-009-R-02: Anti-Aircraft Range 4B; FTSW-010-R-01: Anti-Tank Range 90-MM-2; and FTSW-011-R-01: Grenade Launcher Range. The investigation may be extended if items are identified near site boundaries, however, the investigation will not extend into the operational range. See Work Plan Figures 1-5 through 1-10.</td></tr>
<tr><td>Timeframe</td><td>September 2013 through September 2016</td></tr>
<tr><td>Practical Constraints</td><td>Heat in summer months.</td></tr>
<tr><td>Scale</td><td>See Work Plan Figures 1-5 through 1-10.</td></tr>
</table>

DQO Elements		DQO Output RFI
5. Develop A Decision Rule	Decision Rules	• If no potential MC release (i.e., exposed filler, buried DMM, or a small arms berm not previously characterized) is identified during the RFI field activities, then no sampling for MC is required and no further action is required with respect to MC. • If a potential MC source (i.e., exposed filler, buried DMM, or a small arms berm not previously characterized) is suspected, then sampling is required to determine MC concentrations. Soil samples will be collected and analyzed for MC Metals and /or explosives depending on the items prompting the sampling. • If sample results do not exceed background screening values (metals only) or the results do not exceed appropriate human health or ecological screening criteria of *USEPA Regional Screening Level Summary Table, Residential Soil*, June 2015, then no further action relative to MC is required. • If sample results exceed background screening values (metals only) and appropriate human health or ecological screening criteria of *USEPA Regional Screening Level Summary Table, Residential Soil*, June 2015; then collect additional samples as needed to determine the nature and extent of contamination. • If sample results exceed background screening values (metals only) and appropriate human health or ecological screening criteria of *USEPA Regional Screening Level Summary Table, Residential Soil*, June 2015; then perform a quantitative risk assessment for MC to determine if further action is required. • If there is unacceptable risk associated with MC, then evaluate corrective measures in a CMS.
6. Specify Tolerable Limits On Decision Errors	Tolerance Limits	The data will be of the quantity and quality necessary to provide technically sound and defensible assessments of potential risks and hazards to human health and the environment by meeting the precision, accuracy, representativeness, comparability, completeness (95%), and sensitivity requirements as described in Worksheet #37 and as evaluated by the data validation process. The project criteria are provided in Worksheets #12, #15, #19, and #28, which are based upon the *DoD Quality Systems Manual for Environmental Laboratories, Final Version 5.0* (DoD, 2013) and cited EPA SW-846 methodology. Data will be compared to the screening levels provided in Worksheet #15. Specifically, the null hypothesis (H0) is: Soil sample concentrations at FTSW MRSs are impacted for MC metals and/or explosives exceeding the USEPA Regional Screening Level Summary Table, Residential Soil, June 2015; Hazard Index = 0.1 or and warrant additional investigation and remedial actions. The alternative hypothesis (Ha) is: Soil sample concentrations at FTSW MRSs are not impacted for MC metals and/or explosive constituents below the USEPA Regional Screening Level Summary Table, Residential Soil, June 2015; Hazard Index = 0.1 and do not warrant additional investigation and/or remedial actions. The false positive decision error occurs when H0 is erroneously rejected corresponding to decision error I. The false negative decision error occurs when Ha is erroneously accepted corresponding to decision error II. Project-specific Type I and II error rates are 0.05 and 0.2, respectively.

DQO Elements		**DQO Output**
		RFI
7. Optimize The Design For Obtaining Data	Sampling Design	In the event that DMM pits are found or individual munitions with exposed fillers, then two discrete soil samples will be collected, one directly beneath the item(s) and one from a depth of one foot below the item(s) to determine if MC has migrated. If these results exceed background and health-based screening levels, then additional delineation and additional media sampling may need to be performed. Further discussion may be found in Worksheet #17.

QAPP Worksheet #12.1: Measurement Performance Criteria - Metals
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)
Page 1 of 3

Matrix: Soil, Sediment, Surface Water

Analytical Group or Method: MC and Geochemical Metals by USEPA SW-846 Method 6010C Modified

Analytical Group or Method: Lead by USEPA SW-846 Method 6010C Modified

Concentration Level: Low

<table>
<tr><th>Data Quality Indicator</th><th>QC Sample or Measurement Performance Activity</th><th>Measurement Performance Criteria[1]</th></tr>
<tr><td>Overall Accuracy/Bias (Absence of interference / contamination)</td><td>Equipment Blank
(See Worksheet #20 – Not needed if using disposable equipment)</td><td>All Target Compounds <1/2 LOQ. (See Worksheet #20 – Not needed if using disposable equipment).
The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. Project quantitation limits (QLs) for all target compounds are specified in: Worksheets #15.1 and #15.2 for ICP metals solids.</td></tr>
<tr><td>Field Precision</td><td>Field Duplicate
(See Worksheet #20)</td><td>All Target Compounds: RPD≤35%.
Relative percent difference (RPD) (%) = [(XA-XB)/ XM] * 100
Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2</td></tr>
<tr><td>Laboratory Accuracy/Bias (Absence of interference / contamination)</td><td>Method Blank (MB)</td><td>All Target Compounds <1/2 LOQ.
The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheets #15.1 and #15.2 for ICP metals solids.</td></tr>
<tr><td>Analytical Laboratory Accuracy</td><td>Laboratory Control Sample (LCS)</td><td>QC acceptance criteria for all target compounds as specified below:
<table>
<tr><th colspan="4">ICP Metals: Matrix = Solids/Sediments/Waters</th></tr>
<tr><th>Analyte</th><th>CAS Number</th><th>LCS Control Limits (%R) Soils/Sediments</th><th>LCS Control Limits (%R) Waters</th></tr>
<tr><td>Aluminum</td><td>7429-90-5</td><td>74-119</td><td>86-115</td></tr>
<tr><td>Antimony</td><td>7440-36-0</td><td>79-114</td><td>88-113</td></tr>
<tr><td>Calcium</td><td>7440-70-2</td><td>81-116</td><td>87-113</td></tr>
<tr><td>Chromium</td><td>7440-47-3</td><td>85-113</td><td>90-113</td></tr>
<tr><td>Copper</td><td>7440-50-8</td><td>81-117</td><td>86-114</td></tr>
<tr><td>Iron</td><td>7439-89-6</td><td>81-118</td><td>87-115</td></tr>
<tr><td>Lead</td><td>7439-92-1</td><td>81-112</td><td>86-113</td></tr>
<tr><td>Magnesium</td><td>7439-95-4</td><td>78-115</td><td>85-113</td></tr>
<tr><td>Manganese</td><td>7439-96-5</td><td>84-114</td><td>90-114</td></tr>
<tr><td>Zinc</td><td>7440-66-6</td><td>82-113</td><td>87-115</td></tr>
</table>
%Recovery (%R) = (Calculated Value / True Value) *100%</td></tr>
</table>

QAPP Worksheet #12.1: Measurement Performance Criteria - Metals
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

<table>
<tr><th>Data Quality Indicator</th><th>QC Sample or Measurement Performance Activity</th><th>Measurement Performance Criteria[1]</th></tr>
<tr><td>Analytical Accuracy (Field Samples)</td><td>Matrix Spike (MS)</td><td>QC acceptance criteria for all target compounds as specified below:
<table>
<tr><td colspan="4">ICP Metals: Matrix = Solids/Sediments/Waters</td></tr>
<tr><th>Analyte</th><th>CAS Number</th><th>MS Control Limits (%R) Soils/Sediments</th><th>MS Control Limits (%R) Waters</th></tr>
<tr><td>Aluminum</td><td>7429-90-5</td><td>74-119</td><td>86-115</td></tr>
<tr><td>Antimony</td><td>7440-36-0</td><td>79-114</td><td>88-113</td></tr>
<tr><td>Calcium</td><td>7440-70-2</td><td>81-116</td><td>87-113</td></tr>
<tr><td>Chromium</td><td>7440-47-3</td><td>85-113</td><td>90-113</td></tr>
<tr><td>Copper</td><td>7440-50-8</td><td>81-117</td><td>86-114</td></tr>
<tr><td>Iron</td><td>7439-89-6</td><td>81-118</td><td>87-115</td></tr>
<tr><td>Lead</td><td>7439-92-1</td><td>81-112</td><td>86-113</td></tr>
<tr><td>Magnesium</td><td>7439-95-4</td><td>78-115</td><td>85-113</td></tr>
<tr><td>Manganese</td><td>7439-96-5</td><td>84-114</td><td>90-114</td></tr>
<tr><td>Zinc</td><td>7440-66-6</td><td>82-113</td><td>87-115</td></tr>
</table>
%R = (Calculated Value – Sample Value / True Value) *100%</td></tr>
<tr><td>Analytical Precision and Accuracy (Field Samples)</td><td>Matrix Spike Duplicate (MSD) or Sample Duplicate (SD)</td><td>QC acceptance criteria for all target compounds as specified below:
<table>
<tr><td colspan="5">ICP Metals: Matrix = Solids/Sediments/Waters</td></tr>
<tr><th>Analyte</th><th>CAS Number</th><th>MSD Control Limits (%R) Soils/Sediments</th><th>MSD Control Limits (%R) Waters</th><th>Precision Limit (RPD)</th></tr>
<tr><td>Aluminum</td><td>7429-90-5</td><td>74-119</td><td>86-115</td><td>30</td></tr>
<tr><td>Antimony</td><td>7440-36-0</td><td>79-114</td><td>88-113</td><td>30</td></tr>
<tr><td>Calcium</td><td>7440-70-2</td><td>81-116</td><td>87-113</td><td>30</td></tr>
<tr><td>Chromium</td><td>7440-47-3</td><td>85-113</td><td>90-113</td><td>30</td></tr>
<tr><td>Copper</td><td>7440-50-8</td><td>81-117</td><td>86-114</td><td>30</td></tr>
<tr><td>Iron</td><td>7439-89-6</td><td>81-118</td><td>87-115</td><td>30</td></tr>
<tr><td>Lead</td><td>7439-92-1</td><td>81-112</td><td>86-113</td><td>30</td></tr>
<tr><td>Magnesium</td><td>7439-95-4</td><td>78-115</td><td>85-113</td><td>30</td></tr>
<tr><td>Manganese</td><td>7439-96-5</td><td>84-114</td><td>90-114</td><td>30</td></tr>
<tr><td>Zinc</td><td>7440-66-6</td><td>82-113</td><td>87-115</td><td>30</td></tr>
</table>
%R = (Calculated Value – Sample Value / True Value) *100%
Relative percent difference (RPD) (%) = [(XA-XB)/ XM] * 100
Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2</td></tr>
</table>

QAPP Worksheet #12.1: Measurement Performance Criteria - Metals
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria[1]
Accuracy	Interference Check Sample (ICS)	ICS-A: Absolute value of concentration for all non-spiked analytes < limit of detection (LOD) (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ± 20% of true value.
Precision (Field Samples)	Serial Dilution Test	Five-fold dilution must agree within ± 10% of the original measurement. Only applicable for samples with concentrations >50× DL for ICP.
Accuracy (Instrument sensitivity control) (ICP mass spectrometry [ICPMS])	Internal Standards	For ICPMS: Internal standard intensity within 30-120% of intensity of the internal standards (IS) in the initial calibration (ICAL).
Sensitivity	Limit of Quantitation (LOQ) verification sample (Quarterly)	Recovery within ±20% of LOQ
Completeness	Analytical Sample Completeness (Usability)	QC acceptance criteria: ≥95% for ICP metals solids. % Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (# of Proposed Samples) / (Total # of Samples Collected)

[1] The laboratory precision and accuracy method performance criteria are based upon the *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Final Version 5.0* (DoD, 2013). If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

QAPP Worksheet #12.2: Measurement Performance Criteria - Explosives
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

Matrix: Soil, Sediment, Surface Water

Analytical Group or Method: Explosives by USEPA SW-846 Method 8330A Modified

Concentration Level: Low

<table>
<tr><th>Data Quality Indicator</th><th>QC Sample or Measurement Performance Activity</th><th>Measurement Performance Criteria[1]</th></tr>
<tr><td>Overall Accuracy/Bias (Absence of interference / contamination)</td><td>Equipment Blank
(See Worksheet #20 – Not needed if using disposable equipment)</td><td>All Target Compounds <1/2 LOQ. (See Worksheet #20 – Not needed if using disposable equipment).
The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. Project quantitation limits (QLs) for all target compounds are specified in: Worksheets #15.3 and #15.4 for explosives solids.</td></tr>
<tr><td>Field Precision</td><td>Field Duplicate
(See Worksheet #20)</td><td>All Target Compounds: RPD≤35%.
Relative percent difference (RPD) (%) = [(XA-XB)/ XM] * 100
Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2</td></tr>
<tr><td>Laboratory Accuracy/Bias (Absence of interference / contamination)</td><td>Method Blank (MB)</td><td>All Target Compounds <1/2 LOQ.
The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheets #15.3 and #15.4 for explosives solids.</td></tr>
<tr><td>Analytical Laboratory Accuracy</td><td>Laboratory Control Sample (LCS)</td><td>QC acceptance criteria for all target compounds as specified below:
<table>
<tr><th colspan="4">Explosives: Matrix = Solids/Sediments/Waters</th></tr>
<tr><th>Analyte</th><th>CAS Number</th><th>LCS Control Limits (%R) Soils/Sediments</th><th>LCS Control Limits (%R) Waters</th></tr>
<tr><td>1,3,5-Trinitrobenzene</td><td>99-35-4</td><td>78-121</td><td>65-140</td></tr>
<tr><td>1,3-Dinitrobenzene</td><td>99-65-0</td><td>83-115</td><td>45-160</td></tr>
<tr><td>2,4,6-Trinitrotoluene</td><td>118-96-7</td><td>69-129</td><td>50-145</td></tr>
<tr><td>2,4-Dinitrotoluene</td><td>121-14-2</td><td>80-118</td><td>60-135</td></tr>
<tr><td>2,6-Dinitrotoluene</td><td>606-20-2</td><td>74-122</td><td>60-135</td></tr>
<tr><td>2-Amino-4,6-Dinitrotoluene</td><td>35572-78-2</td><td>75-118</td><td>50-155</td></tr>
<tr><td>2-Nitrotoluene</td><td>88-72-2</td><td>77-118</td><td>45-135</td></tr>
<tr><td>3-Nitrotoluene</td><td>99-08-1</td><td>75-118</td><td>50-130</td></tr>
<tr><td>4-Amino-2,6-Dinitrotoluene</td><td>19406-51-0</td><td>75-122</td><td>55-155</td></tr>
<tr><td>4-Nitrotoluene</td><td>99-99-0</td><td>76-118</td><td>50-130</td></tr>
<tr><td>HMX</td><td>2691-41-0</td><td>71-120</td><td>80-115</td></tr>
<tr><td>Nitrobenzene</td><td>98-95-3</td><td>82-116</td><td>50-140</td></tr>
<tr><td>Nitroglycerin</td><td>55-63-0</td><td>77-123</td><td>50-140</td></tr>
<tr><td>PETN</td><td>78-11-5</td><td>74-123</td><td>50-150</td></tr>
<tr><td>RDX</td><td>121-82-4</td><td>63-125</td><td>50-160</td></tr>
<tr><td>Tetryl</td><td>479-45-8</td><td>10-165</td><td>20-175</td></tr>
</table>
%Recovery (%R) = (Calculated Value / True Value) *100%</td></tr>
</table>

QAPP Worksheet #12.2: Measurement Performance Criteria - Explosives
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria[1]
Analytical Accuracy (Field Samples)	MS	QC acceptance criteria for all target compounds as specified below:

Explosives: Matrix = Solids/Sediments/Waters

Analyte	CAS Number	MS Control Limits (%R) Soils/Sediments	MS Control Limits (%R) Waters
1,3,5-Trinitrobenzene	99-35-4	78-121	65-140
1,3-Dinitrobenzene	99-65-0	83-115	45-160
2,4,6-Trinitrotoluene	118-96-7	69-129	50-145
2,4-Dinitrotoluene	121-14-2	80-118	60-135
2,6-Dinitrotoluene	606-20-2	74-122	60-135
2-Amino-4,6-Dinitrotoluene	35572-78-2	75-118	50-155
2-Nitrotoluene	88-72-2	77-118	45-135
3-Nitrotoluene	99-08-1	75-118	50-130
4-Amino-2,6-Dinitrotoluene	19406-51-0	75-122	55-155
4-Nitrotoluene	99-99-0	76-118	50-130
HMX	2691-41-0	71-120	80-115
Nitrobenzene	98-95-3	82-116	50-140
Nitroglycerin	55-63-0	77-123	50-140
PETN	78-11-5	74-123	50-150
RDX	121-82-4	63-125	50-160
Tetryl	479-45-8	10-165	20-175

%R = (Calculated Value – Sample Value / True Value) *100%

QAPP Worksheet #12.2: Measurement Performance Criteria - Explosives
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)

Data Quality Indicator	QC Sample or Measurement Performance Activity	Measurement Performance Criteria[1]
Analytical Precision and Accuracy (Field Samples)	MSD or SD	QC acceptance criteria for all target compounds as specified below: (see table below) %R = (Calculated Value – Sample Value / True Value) *100% Relative percent difference (RPD) (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2
Analytical Accuracy	Surrogates	QC acceptance criteria: 1,2-Dinitrobenzene 74-128% for explosives solids. %R = (Calculated Value / True Value) *100%
Representativeness	Positive Confirmations	Confirmed on dissimilar columns with RPD≤40%.
Completeness	Analytical Sample Completeness (Usability)	QC acceptance criteria: ≥95% for ICP metals solids. % Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (# of Proposed Samples) / (Total # of Samples Collected)

Explosives: Matrix = Solids/Sediments/Waters

Analyte	CAS Number	MSD Control Limits (%R) Soils/Sediments	MSD Control Limits (%R) Waters	Precision Limit (RPD)
1,3,5-Trinitrobenzene	99-35-4	78-121	65-140	30
1,3-Dinitrobenzene	99-65-0	83-115	45-160	30
2,4,6-Trinitrotoluene	118-96-7	69-129	50-145	30
2,4-Dinitrotoluene	121-14-2	80-118	60-135	30
2,6-Dinitrotoluene	606-20-2	74-122	60-135	30
2-Amino-4,6-Dinitrotoluene	35572-78-2	75-118	50-155	30
2-Nitrotoluene	88-72-2	77-118	45-135	30
3-Nitrotoluene	99-08-1	75-118	50-130	30
4-Amino-2,6-Dinitrotoluene	19406-51-0	75-122	55-155	30
4-Nitrotoluene	99-99-0	76-118	50-130	30
HMX	2691-41-0	71-120	80-115	30
Nitrobenzene	98-95-3	82-116	50-140	30
Nitroglycerin	55-63-0	77-123	50-140	30
PETN	78-11-5	74-123	50-150	30
RDX	121-82-4	63-125	50-160	30
Tetryl	479-45-8	10-165	20-175	30

[1] The laboratory precision and accuracy method performance criteria are based upon the *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Final Version 5.0* (DoD, 2013). If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

QAPP Worksheet #12.3: Measurement Performance Criteria - TOC and pH
(UFP-QAPP Manual Section 2.6.2) (EPA 2106-G-05 Section 2.2.6)
Page 1 of 1

Matrix: Soil, Sediment, Surface Water
Analytical Group or Method: TOC by Lloyd Kahn and pH USEPA SW-846 Method 9045D
Concentration Level: Low

<table>
<tr><th>Data Quality Indicator</th><th>QC Sample or Measurement Performance Activity</th><th>Measurement Performance Criteria[1]</th></tr>
<tr><td>Laboratory Accuracy/Bias (Absence of interference / contamination)</td><td>MB</td><td>All Target Compounds <1/2 LOQ.
The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheets #15.5 and #15.6 for TOC solids and NA for pH.</td></tr>
<tr><td>Analytical Laboratory Accuracy</td><td>LCS</td><td>QC acceptance criteria for all target compounds as specified below:
<table>
<tr><td colspan="4">TOC and pH: Matrix = Solids/Sediments/Waters</td></tr>
<tr><td>Analyte</td><td>CAS Number</td><td>LCS Control Limits (%R) Soils/Sediments</td><td>LCS Control Limits (%R) Waters</td></tr>
<tr><td>Total Organic Carbon</td><td>TOC</td><td>84-113</td><td>85-111</td></tr>
<tr><td>pH</td><td>pH</td><td>Not Applicable</td><td>Not Applicable</td></tr>
</table>
%Recovery (%R) = (Calculated Value / True Value) *100%</td></tr>
<tr><td>Analytical Accuracy (Field Samples)</td><td>MS</td><td>QC acceptance criteria for all target compounds as specified below:
<table>
<tr><td colspan="4">TOC and pH: Matrix = Solids/Sediments/Waters</td></tr>
<tr><td>Analyte</td><td>CAS Number</td><td>MS Control Limits (%R)</td><td>MS Control Limits (%R) Waters</td></tr>
<tr><td>Total Organic Carbon</td><td>TOC</td><td>Not Applicable</td><td>Not Applicable</td></tr>
<tr><td>pH</td><td>pH</td><td>Not Applicable</td><td>Not Applicable</td></tr>
</table>
uses LCS criteria. %R = (Calculated Value – Sample Value / True Value) *100%</td></tr>
<tr><td>Analytical Precision and Accuracy (Field Samples)</td><td>MSD or SD</td><td>QC acceptance criteria for all target compounds as specified below:
<table>
<tr><td colspan="5">TOC and pH: Matrix = Solids/Sediments/Waters</td></tr>
<tr><td>Analyte</td><td>CAS Number</td><td>MSD Control Limits (%R) Soils/Sediments</td><td>MSD Control Limits (%R) Waters</td><td>Precision Limit (RPD)</td></tr>
<tr><td>Total Organic Carbon</td><td>TOC</td><td>Not Applicable</td><td>Not Applicable</td><td>30</td></tr>
<tr><td>pH</td><td>pH</td><td>Not Applicable</td><td>Not Applicable</td><td>Not Applicable</td></tr>
</table>
%R = (Calculated Value – Sample Value / True Value) *100%
Relative percent difference (RPD) (%) = [(XA-XB)/ XM] * 100
Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2</td></tr>
<tr><td>Completeness</td><td>Analytical Sample Completeness (Usability)</td><td>QC acceptance criteria: ≥95% for TOC and pH solids.
% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses)
% Sampling Completeness = 100 * (# of Proposed Samples) / (Total # of Samples Collected)</td></tr>
</table>

[1] The laboratory precision and accuracy method performance criteria are based upon the *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Final Version 5.0* (DoD, 2013). If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

QAPP Worksheet #13: Secondary Data Uses and Limitations
(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

Data Type	Source	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Existing MC Site Data	Final Phase 2 Confirmatory Sampling Report, Fort Stewart, Georgia (Arcadis/Malcolm Pirnie, Inc., 2011)	• The data will be used to show that there is no MC release. • The data may be used, if found to be suitable for risk assessment purposes, in combination with new RFI data if collected. • Data will be used to characterize the nature and extent of MC in the MRSs.	The data are somewhat limited in scope, as it was collected to assess only the presence/absence of contamination.
Existing MC Background Data	Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, Georgia, Volume I of III (2000)	• Provides background levels of metals in soil at FTSW.	The data needs to be evaluated for similarity of soil type.

QAPP Worksheets #14 & 16: Project Tasks and Schedule
(UFP-QAPP Manual Section 2.8.2) (EPA 2106-G-05 Section 2.2.4)

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Scheduled Deliverable Due Date
Technical Project Planning (TPP) #1	CB&I	02/2014	02/2014	TPP #1 Presentation	02/2014
Work Plan, Draft	CB&I	03/2014	06/2014 for review	Work Plan, Draft	06/2014
UFP-QAPP, Draft	CB&I	03/2014	06/2014 for review	UFP-QAPP, Draft	06/2014
Work Plan, Draft Final	CB&I	06/2014	07/2014 for review	Work Plan, Draft Final	07/2014
UFP-QAPP, Draft Final	CB&I	06/2014	07/2014 for review	UFP-QAPP, Draft Final	07/2014
TPP #2	CB&I	08/2014	08/2014	TPP #2 Presentation	08/2014
Work Plan, Final	CB&I	09/2014	10/2014 for review	Work Plan, Final	10/2014
UFP-QAPP, Final	CB&I	09/2014	10/2014 for review	UFP-QAPP, Final	10/2014
Sample Collection and Laboratory Analysis	CB&I, CT Laboratories, Inc.	11/2014 to 1/2015 for collection 12/2014 to 02/2015 for lab analysis	11/2014 to 1/2015 for collection 12/2014 to 02/2015 for lab analysis	Analytical Reports, Excel File	11/2014 to 1/2015 for collection 12/2014 to 02/2015 for lab analysis
Data Review, Validation, and Usability Assessment	CB&I	12/2014 to 03/2015	12/2014 to 03/2015	Validation Reports, Excel File	12/2014 to 03/2015
RFI Report, Draft	CB&I	03/2015	05/2015 to 05/2015 for review	RFI Report, Draft	05/2015
RFI Report, Draft Final	CB&I	05/2015	06/2015 to 07/2015 for review	RFI Report, Draft Final	07/2015
TPP #3	CB&I	07/2015	08/2015	TPP #3 Presentation	08/2015
RFI Report, Final	CB&I	08/2015	08/2015 to 09/2015 for review	RFI Report, Final	09/2015

QAPP Worksheet #15.1: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits - Metals
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)
Page 1 of 1

Analyte	CAS No.	Project Action Limit[6] (PAL) (mg/kg)	Background Values[7] (mg/kg)	Project Quantitation Limit Goal	DL[1,5] (mg/kg)	LOD[2,5] (mg/kg)	LOQ[3,5] (mg/kg)
Aluminum	7429-90-5	7700	NA	0.24	0.04	0.12	0.24
Antimony	7440-36-0	3.1	NA	0.8	0.13	0.4	0.8
Arsenic	7440-38-2	0.68	NA	0.8	0.13	0.4	0.8
Calcium	7440-70-2	Not Applicable	NA	1.4	0.24	0.7	1.4
Chromium[4]	7440-47-3	0.30	NA	0.14	0.023	0.07	0.14
Copper	7440-50-8	310	NA	0.4	0.07	0.2	0.4
Iron	7439-89-6	5500	NA	1.8	0.3	0.9	1.8
Lead	7439-92-1	400	11.1	0.25	0.04	0.125	0.25
Magnesium	7439-95-4	Not Applicable	NA	0.8	0.14	0.4	0.8
Manganese	7439-96-5	180	NA	0.15	0.025	0.075	0.15
Zinc	7440-66-6	2300	15.5	0.3	0.05	0.15	0.3

[1] Detection Limit (DL): The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value (National Environmental Laboratory Accreditation Conference [NELAC]).

[2] Limit of Detection (LOD): An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent.

[3] Limits of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

[4] Chromium (VI) values used for total chromium PAL.

[5] Achievable DLs, LODs, and QLs/LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed DLs, LODs, and QLs/LOQs are based upon a dilution factor of one and a wet weight basis.

[6] USEPA Regional Screening Level Summary Table, Residential Soil, June 2015; Hazard Index = 0.1.

[7] Phase II RCRA Facility Investigation Report for 16 Solid Waste Management Units at Fort Stewart, GA, 2000.

QAPP Worksheet #15.2: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits - Metals
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)
Page 1 of 1

Analyte	CAS No.	Project Action Limit (PAL) (ug/l)	PAL Reference	Project Quantitation Limit Goal (ug/l)	DL[1,5] (ug/l)	LOD[2,5] (ug/l)	LOQ[3,5] (ug/l)
Aluminum	7429-90-5	2000	*USEPA Regional Screening Level Summary Table, Tap Water, June 2015*; Hazard Index = 0.1	36	6.0	18	36
Antimony	7440-36-0	0.78		12	2.0	6.0	12
Arsenic	7440-38-2	0.052		24	4.0	12	24
Calcium	7440-70-2	Not Applicable		100	17	50	100
Chromium[4]	7440-47-3	0.035		4.0	0.60	2.0	4.0
Copper	7440-50-8	80		7.0	1.2	3.5	7.0
Iron	7439-89-6	1400		100	16	50	100
Lead	7439-92-1	15		4.0	1.4	2.0	4.0
Magnesium	7439-95-4	Not Applicable		40	6.0	20	40
Manganese	7439-96-5	43		4.0	0.70	2.0	4.0
Zinc	7440-66-6	43		10	1.6	5.0	10

[1] Detection Limit (DL): The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value (National Environmental Laboratory Accreditation Conference [NELAC]).

[2] Limit of Detection (LOD): An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent.

[3] Limits of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

[4] Chromium (VI) values used for total chromium PAL.

[5] Achievable DLs, LODs, and QLs/LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed DLs, LODs, and QLs/LOQs are based upon a dilution factor of one and a wet weight basis.

QAPP Worksheet #15.3: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits - Explosives (UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Analyte	CAS No.	Project Action Limit (PAL) (µg/kg)	PAL Reference	Project Quantitation Limit Goal	DL[1,4] (µg/kg)	LOD[2,4] (µg/kg)	LOQ[3,4] (µg/kg)
1,3,5-Trinitrobenzene	99-35-4	220000	*USEPA Regional Screening Level Summary Table, Residential Soil, June 2015*; Hazard Index = 0.1	500	130	150	500
1,3-Dinitrobenzene	99-65-0	630		400	80	150	400
2,4,6-Trinitrotoluene	118-96-7	3600		400	90	150	400
2,4-Dinitrotoluene	121-14-2	1700		500	80	150	500
2,6-Dinitrotoluene	606-20-2	360		250	70	150	250
2-Amino-4,6-Dinitrotoluene	35572-78-2	15000		250	50	150	250
2-Nitrotoluene	88-72-2	3200		500	90	150	500
3-Nitrotoluene	99-08-1	630		250	70	150	250
4-Amino-2,6-Dinitrotoluene	19406-51-0	15000		250	70	150	250
4-Nitrotoluene	99-99-0	25000		400	70	250	400
HMX	2691-41-0	390000		400	120	150	400
Nitrobenzene	98-95-3	5100		250	40	150	250
Nitroglycerin	55-63-0	630		2000	500	600	2000
PETN	78-11-5	13000		2000	500	1000	2000
RDX	121-82-4	6100		500	140	150	500
Tetryl	479-45-8	16000		400	90	250	400

[1] Detection Limit (DL): The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value (NELAC).

[2] Limit of Detection (LOD): An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent.

[3] Limits of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

[4] Achievable DLs, LODs, and QLs/LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed DLs, LODs, and QLs/LOQs are based upon a dilution factor of one and a wet weight basis.

QAPP Worksheet #15.4: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits - Explosives (UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Analyte[5]	CAS No.	Project Action Limit (PAL) (ug/l)	PAL Reference	Project Quantitation Limit Goal (ug/l)	DL[1,4] (ug/l)	LOD[2,4] (ug/l)	LOQ[3,4] (ug/l)
1,3,5-Trinitrobenzene	99-35-4	59	*USEPA Regional Screening Level Summary Table, Tap Water, June 2015*; Hazard Index = 0.1	0.50	0.13	0.30	0.50
1,3-Dinitrobenzene	99-65-0	0.20		0.30	0.08	0.20	0.30
2,4,6-Trinitrotoluene	118-96-7	0.98		0.50	0.09	0.20	0.50
2,4-Dinitrotoluene	121-14-2	0.24		0.30	0.08	0.20	0.30
2,6-Dinitrotoluene	606-20-2	0.048		0.30	0.07	0.20	0.30
2-Amino-4,6-Dinitrotoluene	35572-78-2	3.9		0.30	0.09	0.20	0.30
2-Nitrotoluene	88-72-2	0.31		0.30	0.09	0.20	0.30
3-Nitrotoluene	99-08-1	0.17		0.50	0.11	0.30	0.50
4-Amino-2,6-Dinitrotoluene	19406-51-0	3.9		0.30	0.08	0.20	0.30
4-Nitrotoluene	99-99-0	4.2		0.50	0.10	0.20	0.50
HMX	2691-41-0	100		0.50	0.12	0.30	0.50
Nitrobenzene	98-95-3	0.14		0.50	0.10	0.20	0.50
Nitroglycerin	55-63-0	0.20		2.0	0.50	1.2	2.0
PETN	78-11-5	3.9		2.0	0.60	1.2	2.0
RDX	121-82-4	0.70		0.50	0.14	0.30	0.50
Tetryl	479-45-8	3.9		0.50	0.09	0.20	0.50

[1] Detection Limit (DL): The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value (NELAC).

[2] Limit of Detection (LOD): An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent.

[3] Limits of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

[4] Achievable DLs, LODs, and QLs/LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed DLs, LODs, and QLs/LOQs are based upon a dilution factor of one and a wet weight basis.

[5] Methodology selected for this project does not meet several Tap Water RSL's.

QAPP Worksheet #15.5: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits - TOC and pH
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)
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Analyte	CAS No.	Project Action Limit (PAL) (mg/kg)	PAL Reference	Project Quantitation Limit Goal	DL[1] (mg/kg)	LOD[2] (mg/kg)	LOQ[3] (mg/kg)
Total Organic Carbon (TOC)	TOC	Not Applicable	Not Applicable (Soil Indicator Parameters)	1800	300	900	1800
pH	pH	Not Applicable		±0.1	Not Applicable	Not Applicable	±0.1

[1] Detection Limit (DL): The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value (NELAC).

[2] Limit of Detection (LOD): An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent.

[3] Limits of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

[4] Achievable DLs, LODs, and QLs/LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed DLs, LODs, and QLs/LOQs are based upon a dilution factor of one and a wet weight basis.

QAPP Worksheet #15.6: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits - TOC and pH
(UFP-QAPP Manual Section 2.6.2.3 and Figure 15) (EPA 2106-G-05 Section 2.2.6)

Analyte	CAS No.	Project Action Limit (PAL) (mg/l)	PAL Reference	Project Quantitation Limit Goal	DL[1] (mg/l)	LOD[2] (mg/l)	LOQ[3] (mg/l)
Total Organic Carbon (TOC)	TOC	Not Applicable	Not Applicable	3.0	0.50	1.5	3.0
pH	pH	Not Applicable		±0.1	Not Applicable	Not Applicable	±0.1

[1] Detection Limit (DL): The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value (NELAC).

[2] Limit of Detection (LOD): An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent.

[3] Limits of Quantitation (LOQ): The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

[4] Achievable DLs, LODs, and QLs/LOQs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed DLs, LODs, and QLs/LOQs are based upon a dilution factor of one and a wet weight basis.

Project Objectives:

In regards to MC, the overall objective of the RFI is to define the nature and extent of MC if potential sources (i.e., MEC with exposed fillers, burial pits containing DMM or contaminated munitions debris, or small arms berms [not previously characterized]) are found during the MEC investigation as described in the work plan for the Anti-Aircraft Range - 4B, Anti-Tank Range 90-MM-2, and Grenade Launcher Range MRSs. If no such sources are found, then no additional MC samples will be collected. No surface water, sediment, and groundwater sampling is anticipated to be required unless significant MC concentrations are found in soil, which will be discussed with the Army and regulators to agree on an established approach.

MC Characterization:

It is uncertain what will be encountered during MEC investigations and what amount of sampling will be needed, if any, to complete the RFI. Based on experience at other firing ranges, MC contamination is seldom a problem except for metals where small arms bullets accumulate. The sampling design described in this UFP-QAPP is limited in scope to preliminarily assessing a potential release of MC in the event exposed fillers or an accumulation of buried DMM or MDAS is encountered. This will include a phased approach of a) biased, discrete sampling to determine if MC are present above background and health-based screening levels, followed by b) delineation in soil, if screening levels are exceeded, to establish the horizontal and vertical extent. If the MC contamination is more extensive or justifies sampling of other media, then the findings and proposed approach to further characterization will be provided to the USACE and GAEPD for concurrence in the form of a memorandum.

In the event that individual munitions with exposed fillers are found, then two discrete soil samples will be collected to assess the potential point source release: one directly beneath the item(s) and one from a depth of 1 foot below the item(s) to determine if MC has migrated. Random sampling and incremental sampling methodology would be more appropriate for widespread contamination, which is not anticipated at this time.

If these results exceed background and health-based screening levels, then additional delineation and additional media sampling may need to be performed, which will consist of step out samples in the horizontal and vertical direction, as needed to bind the contamination. The spacing of step out samples will generally be 2 feet, but may be greater or lesser depending on best professional judgment in consideration of the anticipated areal extent of the release and the concentrations observed.

The ProUCL Users Guidance for ecological risk assessment recommends at least eight sample results to be used for the 95% UCL EPC calculations. For small, localized sources of MC contamination, fewer than eight samples is acceptable, and the maximum detected concentration of each analyte will be used in the risk screening and risk assessment.

Discrete samples will be collected using hand tools, such as a disposable decontaminated stainless steel hand auger. Where possible, disposable or dedicated equipment will be used eliminating the need for rinse blanks. The surface soil samples will be collected from 0.0 to 0.5 foot bgs. Subsurface soil samples (if needed) will be collected from 0.5 to 1.5 feet bgs. Sample material will be placed in a clean container and homogenized (per SOPs EI-FS-101 and EI-FS-010, provided in **Attachment 1**) prior to placing the sample into sample containers. Vegetative matter and rocks will be removed from the sample. Any metallic debris (including bullet fragments or fragments from MD) will be removed by hand, and notations made on the sample collection sheet.

Locations of MC samples will be recorded using a handheld GPS and staked/flagged until analytical results are available and it is determined whether additional step out sampling is needed.

The analytical methods and analytes selected to address chemical contaminants will be based on the types of items that prompt MC sampling. This preliminary list could include 40mm, 90mm, and 120mm projectiles, M2 target rockets, 81mm practice mortars, M67 hand grenades, 40mm practice grenades, 2.75" and 3.5" rockets, and M16A1 anti-personnel mines based on historical finds and reported use. The metals and explosives analytical suites as described below will be sufficient to assess potential MC contamination from the anticipated munitions. Should an unanticipated item or filler be encountered, then an assessment of the adequacy of the standard sampling below will be performed to determine if additional analytical parameters should be included.

- MC and Geochemical Metals, USEPA Method SW-846 6010C Modified: Aluminum, Antimony, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, and Zinc.
- Lead, USEPA Method SW-846 6010C Modified if there are small arms concerns.
- Explosives, USEPA Method SW-846 8330A Modified: HMX, RDX, 1,3,5-TNB, 1,3-DNB, Tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2-NT, 3-NT, 4-NT, NG, and PETN.

Method modifications include: The preparation laboratory procedures for soils for metals by 6010C Mod and explosives 8330A Mod analysis will include sieving with a #10 sieve prior to digestion or extraction step. The total weight of the sample, the weight of retained material, and/or the MD should be reported, as applicable. The sample should be qualitatively described and photos may be taken, if necessary, of the contained and retained material (e.g., gravel, twigs, shot, skeet fragments). If necessary for breaking up hard clumps (e.g., dried clay), the samples should be dried and ground. In addition, the explosives 8330A Mod target list will include the additional target compounds PETN and NG.

Additional supporting analysis for TOC and pH is also required for each sample, or at least each soil type. The organic content and pH in different soil types (e.g. clay, loamy, sandy, rocky, etc.) affect compound mobility/absorption rates and thus performing the TOC and pH testing for each soil type aids the risk assessors in drawing their conclusions. The analytical methods include:

- TOC, USEPA Method Lloyd Kahn
- pH, USEPA Method SW-846 9045D

Surface water, sediment, and groundwater sampling is not anticipated to be required unless significant MC concentrations as deemed by CB&I, USACE, and GAEPD are found in soil, which is considered unlikely based on previous investigations at FTSW. Investigative waste stream sampling is not anticipated to be required. If required, all sampling and monitoring will be performed in accordance with the guidelines specified within this site-specific UFP-QAPP. Further details as to the sampling program are presented in Worksheets #18 and #20.

Field duplicates pairs are to be collected at a frequency of 10% (1 per 10) and matrix spikes at 5% (1 per 20) of the total number of samples collected per matrix. Soil samples are to be collected using disposable equipment where applicable. Equipment (rinse) blanks will not be required if disposable and dedicated equipment is used but will be collected at a rate of 5% (1 per 20) per media per equipment type if reusable equipment is used. Per the project Scope of Work/Performance Work Statement, field QC splits with a QA laboratory are not required for this scope. Project-specific field duplicates and MS/MSD pairs are not required for the pH and TOC indicator analysis. Further details as to the field sampling procedures/methods and sampling equipment that will be required to implement the various sampling programs may be found in the **Attachment 1**.

QAPP Worksheet #18: Sampling Locations and Methods
(UFP-QAPP Manual Sections 3.1.1 and 3.1.2) (EPA 2106-G-05 Sections 2.3.1 and 2.3.2)
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Sample ID[1]	Matrix[2]	Depth (foot bgs)	Type	Analyte/ Analytical Group	Sampling SOP	Comments
Anti-Aircraft Range 4A (FTSW-009-R-01):						
FTSW-AAR4A-SS##	SS	0.0-0.5	Regular	MC and Geochemical Metals; Lead; Explosives; TOC; and/or pH (As needed)	Sample Management (As Needed) Field Logbook, Rev2, 8/25/11, SOP EI-FS001 Field Log Sheets, Rev2, 1/23/12, SOP EI-FS002 Chain-of-Custody (COC) Documentation – Paper, Rev2, 8/25/11, SOP EI-FS003 Custody Seals, Rev2, 8/25/11, SOP EI-FS005 Sample Labeling, Rev2, 8/25/11, SOP EI-FS006 Shipping and Packaging of Non-Hazardous Samples, Rev2, 8/25/11, SOP EI-FS012 Packaging and Shipping of U.S. Department of Transportation (DOT) – Hazardous Samples, Rev2, 8/25/11, SOP EI-FS013 Soil Sampling (As Needed) Sample Homogenization, Rev2, 8/25/11, SOP EI-FS-010; Decontamination, Rev2, 8/25/11, SOP EI-FS-014; Hand Auger, Rev2, 8/25/11, SOP EI-EI-FS-100; Trowel/Spoon, Rev2, 8/25/11, SOP EI-FS-101; Soil Probe Core, Rev2, 8/25/11, SOP EI-FS-103	
FTSW-AAR4A-SS##D	SS	0.0-0.5	Field Duplicate			
FTSW-AAR4A-SB##	SB	TBD	Regular			
FTSW-AAR4A-SB##D	SB	TBD	Field Duplicate			
FTSW-AAR4A-SD##	SD	0.0-0.5	Regular			
FTSW-AAR4A-SD##D	SD	0.0-0.5	Field Duplicate			
FTSW-AAR4A-SW##	SW	TBD	Regular			
FTSW-AAR4A-SW##D	SW	TBD	Field Duplicate			
FTSW-RB##	RB	NA	Equipment Blank			
(See Note[1])						
Anti-Aircraft Range 4A (FTSW-009-R-02):						
FTSW-AAR4B-SS##	SS	0.0-0.5	Regular	MC and Geochemical Metals; Lead; Explosives; TOC; and/or pH (As needed)	Sample Management (As Needed) Field Logbook, Rev2, 8/25/11, SOP EI-FS001 Field Log Sheets, Rev2, 1/23/12, SOP EI-FS002 COC Documentation – Paper, Rev2, 8/25/11, SOP EI-FS003 Custody Seals, Rev2, 8/25/11, SOP EI-FS005 Sample Labeling, Rev2, 8/25/11, SOP EI-FS006 Shipping and Packaging of Non-Hazardous Samples, Rev2, 8/25/11, SOP EI-FS012 Packaging and Shipping of DOT – Hazardous Samples, Rev2, 8/25/11, SOP EI-FS013 Soil Sampling (As Needed) Sample Homogenization, Rev2, 8/25/11, SOP EI-FS-010; Decontamination, Rev2, 8/25/11, SOP EI-FS-014; Hand Auger, Rev2, 8/25/11, SOP EI-EI-FS-100; Trowel/Spoon, Rev2, 8/25/11, SOP EI-FS-101; Soil Probe Core, Rev2, 8/25/11, SOP EI-FS-103	
FTSW-AAR4B-SS##D	SS	0.0-0.5	Field Duplicate			
FTSW-AAR4B-SB##	SB	TBD	Regular			
FTSW-AAR4B-SB##D	SB	TBD	Field Duplicate			
FTSW-AAR4B-SD##	SD	0.0-0.5	Regular			
FTSW-AAR4B-SD##D	SD	0.0-0.5	Field Duplicate			
FTSW-AAR4B-SW##	SW	TBD	Regular			
FTSW-AAR4B-SW##D	SW	TBD	Field Duplicate			
FTSW-RB##	RB	NA	Equipment Blank			
(See Note[1])						

QAPP Worksheet #18: Sampling Locations and Methods
(UFP-QAPP Manual Sections 3.1.1 and 3.1.2) (EPA 2106-G-05 Sections 2.3.1 and 2.3.2)

Sample ID[1]	Matrix[2]	Depth (foot bgs)	Type	Analyte/ Analytical Group	Sampling SOP	Comments
Anti-Tank Range 90-MM-2 (FTSW-010-R-01):						
FTSW-ATR90-SS##	SS	0.0-0.5	Regular	MC and Geochemical Metals; Lead; Explosives; TOC; and/or pH (As needed)	Sample Management (As Needed) Field Logbook, Rev2, 8/25/11, SOP EI-FS001 Field Log Sheets, Rev2, 1/23/12, SOP EI-FS002 COC Documentation – Paper, Rev2, 8/25/11, SOP EI-FS003 Custody Seals, Rev2, 8/25/11, SOP EI-FS005 Sample Labeling, Rev2, 8/25/11, SOP EI-FS006 Shipping and Packaging of Non-Hazardous Samples, Rev2, 8/25/11, SOP EI-FS012 Packaging and Shipping of DOT – Hazardous Samples, Rev2, 8/25/11, SOP EI-FS013 Soil/Sediment Sampling (As Needed) Sample Homogenization, Rev2, 8/25/11, SOP EI-FS-010; Decontamination, Rev2, 8/25/11, SOP EI-FS-014; Hand Auger, Rev2, 8/25/11, SOP EI-EI-FS-100; Trowel/Spoon, Rev2, 8/25/11, SOP EI-FS-101; Soil Probe Core, Rev2, 8/25/11, SOP EI-FS-103	
FTSW-ATR90-SS##D	SS	0.0-0.5	Field Duplicate			
FTSW-ATR90-SB##	SB	TBD	Regular			
FTSW-ATR90-SB##D	SB	TBD	Field Duplicate			
FTSW-ATR90-SD##	SD	0.0-0.5	Regular			
FTSW-ATR90-SD##D	SD	0.0-0.5	Field Duplicate			
FTSW-ATR90-SW##	SW	TBD	Regular			
FTSW-ATR90-SW##D	SW	TBD	Field Duplicate			
FTSW-RB##	RB	NA	Equipment Blank			
(See Note[1])						
Grenade Launcher Range (FTSW-011-R-01):						
FTSW-GLR-SS##	SS	0.0-0.5	Regular	MC and Geochemical Metals; Lead; Explosives; TOC; and/or pH (As needed)	Sample Management (As Needed) Field Logbook, Rev2, 8/25/11, SOP EI-FS001 Field Log Sheets, Rev2, 1/23/12, SOP EI-FS002 COC Documentation – Paper, Rev2, 8/25/11, SOP EI-FS003 Custody Seals, Rev2, 8/25/11, SOP EI-FS005 Sample Labeling, Rev2, 8/25/11, SOP EI-FS006 Shipping and Packaging of Non-Hazardous Samples, Rev2, 8/25/11, SOP EI-FS012 Packaging and Shipping of DOT – Hazardous Samples, Rev2, 8/25/11, SOP EI-FS013 Soil/Sediment Sampling (As Needed) Sample Homogenization, Rev2, 8/25/11, SOP EI-FS-010; Decontamination, Rev2, 8/25/11, SOP EI-FS-014; Hand Auger, Rev2, 8/25/11, SOP EI-EI-FS-100; Trowel/Spoon, Rev2, 8/25/11, SOP EI-FS-101; Soil Probe Core, Rev2, 8/25/11, SOP EI-FS-103	
FTSW-GLR-SS##D	SS	0.0-0.5	Field Duplicate			
FTSW-GLR-SB##	SB	TBD	Regular			
FTSW-GLR-SB##D	SB	TBD	Field Duplicate			
FTSW-GLR-SD##	SD	0.0-0.5	Regular			
FTSW-GLR-SD##D	SD	0.0-0.5	Field Duplicate			
FTSW-GLR-SW##	SW	TBD	Regular			
FTSW-GLR-SW##D	SW	TBD	Field Duplicate			
FTSW-RB##	RB	NA	Equipment Blank			
(See Note[1])						

[1] No significant MC releases are anticipated at the FTSW Site. Sample IDs are provided in the event that MC sampling is performed, as discussed in Worksheet #17.

[2] Key: FTSW = Fort Stewart; AAR = Anti-Aircraft Range; ATR = Anti-Tank Range; GLR = Grenade Launcher Range; SS = Surface Soil; SB = Subsurface Soil; SD = Sediment; SW=Surface Water RB = Rinse Blank

QAPP Worksheets #19 & 30: Sample Containers, Preservation, and Hold Times
(UFP-QAPP Manual Section 3.1.2.2) (EPA 2106-G-05 Section 2.3.2)

Primary Laboratory:	CT Laboratories, Inc. Eric Korthals 1230 Lange Court Baraboo, WI 53913-3109 ekorthals@ctlaboratories.com Phone: (608) 356-2760 Fax: (608) 356-2766 ELAP Accreditation #3317.01	Backup Laboratory:	Gulf Coast Analytical Laboratories, Inc. Sean Hardin 7979 GSRI Avenue Baton Rouge, LA 70820-7402 sean.hardin@gcal.com Phone: (225) 769-4900 Fax: (704) 607-7735 ELAP Accreditation #74960

Sample Delivery Method: All certified, pre-cleaned sampling containers of appropriate size and composition shall include all necessary chemical preservatives to facilitate proper collection and shipment and shall be supplied with coolers, packing materials, temperature blanks, custody seals, and courier air bills by the subcontract laboratory to the job site or designated address by CB&I. Field collected samples may be held on site in a secured area under proper preservation at the discretion of the field lead to expedite the field collection process, not to exceed one week and in consideration of method holding times and sample turnaround times. All field collected samples shall be shipped to the laboratory Priority Next Calendar Day (via Fed Ex or UPS) and with double bagged ice (if required).

Backup Laboratory: It is unlikely a backup laboratory will be required for this project. If a backup laboratory is required due to laboratory loading or any other issues, CT Laboratories, Inc. will subcontract accordingly. The backup laboratory has to meet all of the requirements specified in this UFP-QAPP. Eric Korthals (CT Labs) will still serve as the Laboratory PM for this CB&I project. CT Labs will notify the CB&I Project Chemist prior to any sample transfers. All laboratories must carry Environmental Laboratory Accreditation Program (ELAP) accreditation (as applicable) and have proper instrumentation and qualifications to perform the analysis required by this project.

QAPP Worksheets #19 & 30: Sample Containers, Preservation, and Hold Times
(UFP-QAPP Manual Section 3.1.2.2) (EPA 2106-G-05 Section 2.3.2)
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Analyte/ Analyte Group	Matrix	Method/ SOP[2]	Accreditation Expiration Date	Container(s) (number, size & type per sample)[1]	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
MC and Geochemical ICP Metals	Soil/Sediment	SW-846 3050B/6010C Modified Lab SOP: MT007, MT009	04/30/2016	(1) 4 oz jar	Cool 4°C ± 2°C	6 months	6 months	15 Business Day Hardcopy/EDDs
Lead	Soil/Sediment	SW-846 3050B/6010C Modified Lab SOP: MT007, MT009	04/30/2016	(1) 4 oz jar	Cool 4°C ± 2°C	6 months	6 months	15 Business Day Hardcopy/EDDs
Explosives (Discrete Sampling)	Soil/Sediment	SW-846 8330A Modified Lab SOP: SV010	04/30/2016	(1) 8 oz jar	Cool 4°C ± 2°C	14 days	40 days	15 Business Day Hardcopy/EDDs
TOC	Soil/Sediment	Lloyd Kahn Lab SOP: WC 040	04/30/2016	(1) 4 oz jar	None	28 days	28 days	15 Business Day Hardcopy/EDDs
pH	Soil/Sediment	SW-846 9045D Lab SOP: WC021	04/30/2016	(1) 4 oz jar	None	ASAP	ASAP	15 Business Day Hardcopy/EDDs
MC and Geochemical ICP Metals	Water	SW-846 3050B/6010C Modified Lab SOP: MT007, MT009	04/30/2016	(1) 250-mL PL	Cool 4 ± 2°C, HNO3	6 months, Hg 28 days	6 months, Hg 28 days	15 Business Day Hardcopy/EDDs
Lead	Water	SW-846 3050B/6010C Modified Lab SOP: MT007, MT009	04/30/2016	(1) 250-mL PL	Cool 4 ± 2°C, HNO3	6 months, Hg 28 days	6 months, Hg 28 days	15 Business Day Hardcopy/EDDs
Explosives (Discrete Sampling)	Water	SW-846 8330A Modified Lab SOP: SV010	04/30/2016	(1-2) 1-L Amber Gl	Cool 4 ± 2°C	7 days	40 days	15 Business Day Hardcopy/EDDs
TOC	Water	SW-846 9060A; Lab SOP: WC039	04/30/2016	(1) 125-mL PL	Cool 4 ± 2°C, H2SO4	28 days	28 days	15 Business Day Hardcopy/EDDs
pH	Water	SW-846 9045D Lab SOP: WC021	04/30/2016	(1) 125-mL PL	Cool 4 ± 2°C	Not Applicable	ASAP	15 Business Day Hardcopy/EDDs

[1] Sample size is a minimum; the containers listed will be filled to compensate for any required re-analysis or re-extractions. For samples requiring MS/MSD containers listed should be tripled or as noted by the analytical lab.

[2] Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.

Matrix	Analyte/Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Field Blanks	Equipment Blanks	Trip Blanks	Other	Total # Analyses
Anti-Aircraft Range 4A (FTSW-009-R-01):										
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	MC and Geochemical ICP Metals	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Lead	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Explosives (Discrete Sampling)	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	TOC	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	pH	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
Anti-Aircraft Range 4A (FTSW-009-R-02):										
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	MC and Geochemical ICP Metals	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Lead	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Explosives (Discrete Sampling)	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	TOC	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	pH	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])

Matrix	Analyte/Analytical Group	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Field Blanks	Equipment Blanks[2]	Trip Blanks	Other	Total # Analyses
Anti-Tank Range 90-MM-2 (FTSW-010-R-01):										
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	MC and Geochemical ICP Metals	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Lead	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Explosives (Discrete Sampling)	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	TOC	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	pH	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
Grenade Launcher Range (FTSW-011-R-01):										
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs)	MC and Geochemical ICP Metals	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Lead	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	Explosives (Discrete Sampling)	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	TOC	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])
SS (0.0-0.5 bgs) SB (≥0.5 foot bgs) SD (0.0-0.5 bgs) SW	pH	TBD (See Note[1])	10% Frequency	5% Frequency	5% Frequency	NA	5% Frequency	NA	NA	TBD (See Note[1])

[1] No significant MC releases are anticipated at the FTSW Site. Sampling for MC and Geochemical metals, lead, explosives, TOC, or pH may be implemented at specific locations within any discovered impacted areas where physical evidence suggesting a potential release of MC is observed during intrusive investigations or other RFI activities. The locations and number of samples (including QC samples) to be analyzed will be determined following completion of the MEC investigation based on the results of the surface surveys. No MC sampling is planned. If warranted, the number of samples to be collected at each of the MRSs will be four soil samples per MRS to provide additional data so that, as appropriate, each MRS can be evaluated against screening values. Further details are presented in Worksheets #11 and #17. The following locations, field QC, and methods are proposed in this worksheet.

[2] Equipment (rinse) blanks are not required as disposable equipment will be used.

QAPP Worksheet #21: Field SOPs
(UFP-QAPP Manual Section 3.1.2) (EPA 2106-G-05 Section 2.3.2)

Reference[1]	Title, Revision, Date, and URL (if available)	Originating Organization	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
SOP EI-FS001	Field Logbook, Rev2, 8/25/11	CB&I	Field Documentation	N	Documents observations, sampling information, and other pertinent information on project sites.
SOP EI-FS002	Field Log Sheets, Rev2, 1/23/12	CB&I	Field Documentation	N	Document single location/event information on project sites.
SOP EI-FS003	COC Documentation – Paper, Rev2, 8/25/11	CB&I	Sample Custody	N	Provides requirements for the completion of COC documentation.
SOP EI-FS005	Custody Seals, Rev2, 8/25/11	CB&I	Sample Custody	N	Includes procedure for completion and attachment of custody seals on environmental samples and shipping containers.
SOP EI-FS006	Sample Labeling, Rev2, 8/25/11	CB&I	Sample Custody	N	Provides requirements for completion and attachment of sample labels on environmental sample containers.
SOP EI-FS010	Sample Homogenization, Rev2, 8/25/11	CB&I	NA	N	Establishes method for homogenizing soil, sediment, and other solid/semi-solid matrices so that a uniform matrix is available for sampling.
SOP EI-FS012	Shipping and Packaging of Non-Hazardous Samples, Rev2, 8/25/11	CB&I	Shipping Container	N	Includes sample packaging, shipping, and requirements for non-hazardous samples.
SOP EI-FS013	Packaging and Shipping of DOT – Hazardous Samples, Rev2, 8/25/11	CB&I	Shipping Container	N	Includes sample packaging, shipping, and requirements for Hazardous Samples.
SOP EI-FS014	Decontamination of Contact Sampling Equipment, Rev2, 8/25/11	CB&I	NA	N	Standard to be implemented for decontamination of contact sampling equipment.
SOP EI-FS020	Data Usability Review, Rev2, 8/25/11	CB&I	NA	N	Establish the means by which all subcontracted environmental analytical data will be reviewed for completeness and usability.
SOP EI-FS100	Hand Auger Sampling, Rev2, 8/25/11	CB&I	Hand Auger	N	Methods/procedures for sampling of subsurface soils using hand auger.
SOP EI-FS101	Trowel/Spoon Surface Soil Sampling, Rev2, 8/25/11	CB&I	Trowel / Spoon	N	Methods/procedures for sampling of surface soils using trowels/spoons.
SOP EI-FS103	Soil Sampling using a Soil Probe or Core-Type Sampler, Rev2, 8/25/11	CB&I	Soil Probe or Core Type	N	Methods/procedures for sampling of subsurface soils using soil probe or core-type sampler.

[1] SOPs are included in the UFP-QAPP as **Attachment 1**.

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection
(UFP-QAPP Manual Section 3.1.2.4) (EPA 2106-G-05 Section 2.3.6)

Field Equipment	Activity	SOP Reference[1]	Title or Position of Responsible Person	Frequency	Acceptance Criteria	Corrective Action
Real Time Kinematic GPS or Robotic Total Station	Calibration, Maintenance, Testing, and Inspection	Manufacturer's Instrument Operating and Calibration Manual; DID MMRP-09-004 Geophysical Investigation for Buried Munitions, Operational Procedures and Quality Control Manual, (U.S. Army Engineering and Support Center, Huntsville [USAESCH], 2002), EM 1110-1-4009, Military Munitions Response Actions (USACE, 2007)	Instrument Operator	See SOP Reference	See SOP Reference	See SOP Reference
GPS Camera	Calibration, Maintenance, Testing, and Inspection	Manufacturer's Instrument Operating and Calibration Manual	CB&I Field Lead	See SOP Reference	See SOP Reference	See SOP Reference

[1] All equipment used by CB&I requiring regular maintenance and calibration (i.e., measurement and test equipment [M&TE]), will be stored at the CB&I field office or in CB&I custody. CB&I maintains a sufficient number of backup M&TE, as well as spare parts, if repair is needed to maintain the project schedule. M&TE will be maintained and calibrated in accordance with the manufacturer's specification. M&TE that requires annual off-site calibration will be inspected monthly to ensure that calibration does not overlap. All M&TE in which calibration has expired, does not pass required calibration, or suffers damage while in active use will be removed from the inventory and tagged as “out of service” to prevent inadvertent use. The defective M&TE will not be allowed back in service until repaired or recalibrated against nationally recognized standards. The Field Lead is responsible to assign a person to manage the inventory of all consumables to ensure adequate inventory for the completion of the specific task. All turnkey subcontractors will be responsible for managing and maintaining adequate supplies of consumables and available inventory of spare parts.

Additional equipment, tools, and supplies required for use during the task-specific activity are provided in detail in the appropriate SOP. The SOPs are provided in **Attachment 1**. Should tools, equipment, and/or supplies be required that are not listed in the SOPs, they will be identified on this worksheet and incorporated in the work plan addenda. The CB&I Field Lead or designee will be responsible for assuring that there is an adequate amount of consumable supplies, materials, and spare parts for the completion of the task or will have access to a location in which supplies or materials may be procured in a reasonable period of time so that there will be no adverse effect on the project schedule.

QAPP Worksheet #23: Analytical SOPs
(UFP-QAPP Manual Section 3.2.1) (EPA 2106-G-05 Section 2.3.4)
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SOP #	Title, Date, and URL (if available)[1]	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project? (Y/N)
SOP: PM003	Chemistry & Microbiology Sample Receiving and Processing	Receiving	All	NA	No
SOP: PM003	Chemistry & Microbiology Sample Receiving and Processing	Sample Custody and Storage	All	NA	No
SOP: PM004	Samples Containers: Purchasing, Receipt & Dissemination	Sampling Kits	All	NA	No
SOP: PM003	Chemistry & Microbiology Sample Receiving and Processing	Waste	All	NA	No
SOP: MT007	Acid Digestion of Solids and Semi-Solids for Total Metals by GFAA and ICP	Preparation	All Geochemical Metals – 6010C Modified Lead – 6010C Modified	NA	Yes[2]
SOP: MT009	Inductively coupled plasma-atomic (ICP) emission – ICP-OES 6000	Definitive	All Geochemical Metals – 6010C Modified Lead – 6010C Modified	Trace ICP	No
SOP: WC021	pH – Soils and Waste	Definitive	Soil and Sediment / pH – 9045D	Probe	No
SOP: WC040	Total Organic Carbon in Soil	Definitive	Soil and Sediment/ TOC – Lloyd Kahn	IC Combustion	No
SOP: SV010	Explosives by Modified Method 8330B w/ Extended Analyte List	Definitive	Alll / Explosives – 8330A	HPLC	Yes[2]
SOP: MT004	Acid Digestion of Waters for Total Metals by ICP	Preparation	Aqueous and Geochemical Metals – 6010C Modified Aqueous / Lead – 6010C Modified	NA	No
SOP: WC020	pH - Liquids	Definitive	Aqueous / pH 9040C	Probe	No
SOP: WC039	Total Organic Carbon in Water	Definitive	Aqueous / TOC 9060A	TOC Analyzer	No

[1] Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.

[2] Method modifications include: The preparation laboratory procedures for soils for metals by 6010C Mod and explosives 8330A Mod analysis will include sieving with a #10 sieve prior to digestion or extraction step. The total weight of the sample, the weight of retained material, and/or the MD should be reported, as applicable. The sample should be qualitatively described and photos may be taken, if necessary, of the contained and retained material (e.g., gravel, twigs, shot, skeet fragments). If necessary for breaking up hard clumps (e.g., dried clay), the samples should be dried and ground. In addition, the explosives 8330A Mod target list will include the additional target compounds PETN and NG.

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action	Title/Position Responsible for Corrective Action	SOP Reference
Trace ICP	Per SW-846 6010C Modified; SOP: MT009	Per SW-846 6010C Modified; SOP: MT009	ICAL and ICS prior to sample analysis and performed daily. Second-source calibration verification (ICV) immediately following initial daily calibration. Continuing calibration verification (CCV) analyzed before sample analysis, after every 10 samples, and at the end of the analysis sequence. Calibration blank at once per initial daily calibration. See Worksheet #28.1 for details.	If more than one calibration standard is used, $r \geq 0.995$ or $r^2 \geq 0.99$. ICV and CCV within 10% of expected value. ICS within 20% of expected value. For calibration blank, must be <3 times the IDL or the average of 3 CB must be <3 times the IDL. See Worksheet #28.1 for details.	For ICAL, correct problem then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL, ICS, and blank have passed. For CCV, repeat calibration and re-analyze all samples since last successful calibration. For ICS, re-analyze all affected samples.	Laboratory Analyst and QAO	SOP: MT009
HPLC	Per SW-846 8330A Modified; SOP: SV010	Per SW-846 8330A Modified; SOP: SV010	ICAL prior to sample analysis and performed once per year minimum. ICV immediately following initial daily calibration. CCV analyzed before sample analysis, after every 10 samples, and at the end of the analysis sequence. See Worksheet #28.2 for details.	Min. of 5 calibration standards with the lowest standard concentration at or below the RL. Once calibration curve or line is generated, the lowest calibration standard must be re-analyzed. The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear reg. is used, $r \geq 0.995$ or $r^2 \geq 0.99$. If using internal standardization, ICAL RSD≤20% for 8330A and RSD≤15% for 8330B. All standards within retention time (RT) windows. All CCVs and second source standards D≤15% for 8330A and D≤20% for 8330B. See Worksheet #28.2 for details.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed. For ICV/CCV and RT, repeat calibration and re-analyze all samples since last successful calibration and RT.	Laboratory Analyst and QAO	SOP: SV010

QAPP Worksheet #24: Analytical Instrument Calibration
(UFP-QAPP Manual Section 3.2.2) (EPA 2106-G-05 Section 2.3.6)

Instrument	Calibration Procedure	Calibration Range	Frequency	Acceptance Criteria	Corrective Action	Title/Position Responsible for Corrective Action	SOP Reference
TOC Analyzer	Per Lloyd Kahn; SOP: WC040 Per SW-846 9060A; SOP: WC039	Per Lloyd Kahn; SOP: WC040 Per SW-846 9060A; SOP: WC039	ICAL prior to sample analysis and performed once per year minimum. ICV immediately following initial daily calibration. CCV analyzed before sample analysis, after every 10 samples, and at the end of the analysis sequence. See Worksheet #28.3 for details.	ICAL: Minimum of 5 standards and a calibration blank and r ≥ 0.995. ICV and CCV within 10% of expected value. See Worksheet #28.3 for details.	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed. For ICV/CCV, repeat calibration and re-analyze all samples since last successful calibration.	Laboratory Analyst and QAO	SOP: WC040
pH Probe	Per SW-846 9045D; SOP: WC021 Per SW-846 9040C; SOP: WC020	Per SW-846 9045D; SOP: WC021 Per SW-846 9040C; SOP: WC020	ICAL prior to sample analysis. See Worksheet #28.3 for details.	±0.05 pH units See Worksheet #28.3 for details.	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed.	Laboratory Analyst and QAO	SOP: WC021

QAPP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection (UFP-QAPP Manual Section 3.2.3) (EPA 2106-G-05 Section 2.3.6)

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Title/Position Responsible for Corrective Action	Reference[1]
Trace ICP	Torch, nebulizer, spray chamber, Perform mercury (Hg) alignment, check purge windows. Replace pump windings and gas tanks, check standard and sample flow.	SW-846 6010C Mod	Check connections, flush lines, clean nebulizer	As needed, frequency determined by instrument remaining in calibration and free of interference	Passing calibration; Intensity of 1 part per million Manganese standard within criteria; Monitor IS counts for variation.	Replace, investigate injector, Reconnect sample pathways, recalibrate, reanalyze affected samples Replace windings	Laboratory Analyst	SOP: MT009
HPLC	Lamp and guard column inspection. Pump maintenance. Replace columns, Diode Array Detector (DAD) flow cell windows and ball-valve cartridges as needed, clean/change filters, check eluent reservoirs	SW-846 8330A Mod	Leak and pressure test, guard column and lamp performance	As needed, frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Replace lamp, replace guard column, tighten fittings, recalibrate, reanalyze	Laboratory Analyst	SOP: SV010
TOC Analyzer	Infrared (IR) tube detector maintenance Replace Disposables and check gas flow.	Lloyd Kahn SW-846 9060A	Check connections, clean IR tube	As needed, frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Clean out IR tube, check humidifier, recalibrate, reanalyze	Laboratory Analyst	SOP: WC040 SOP: WC039
pH Probe	Probe and solution inspection	SW-846 9045D Per SW-846 9040C	Check buffer and probe solutions	As needed, Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Remake or purchase new buffer standards, replace probe solutions, re-analyze	Laboratory Analyst	SOP: WC021 SOP: WC020

[1] Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis.

QAPP Worksheets #26 & 27: Sample Handling, Custody, and Disposal
(UFP-QAPP Manual Section 3.3) (EPA 2106-G-05 Section 2.3.3)

Sampling Organization: CB&I
Laboratory: CT Laboratories, Inc.
Method of sample delivery (shipper/carrier): Priority Next Calendar Day (via Fed Ex or UPS)
Number of days from reporting until sample disposal: Minimum of 30 days after final report sent to CB&I

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample labeling	Emily Tucker, MC Sampling Lead, CB&I	SOP EI-FS006
COC form completion	Emily Tucker, MC Sampling Lead, CB&I	SOP EI-FS003
Packaging	David A Berwanger, Laboratory Director, CT Laboratories, Inc. Eric T Korthals, Laboratory PM, CT Laboratories, Inc.	SOP: PM004
	Emily Tucker, MC Sampling Lead, CB&I	SOP EI-FS012 and SOP EI-FS013
Shipping coordination	Emily Tucker, MC Sampling Lead, CB&I	SOP EI-FS012 and SOP EI-FS013
Sample receipt, inspection, & log-in	David A Berwanger, Laboratory Director, CT Laboratories, Inc. Eric T Korthals, Laboratory PM, CT Laboratories, Inc.	SOP: PM003
Sample custody and storage	David A Berwanger, Laboratory Director, CT Laboratories, Inc. Eric T Korthals, Laboratory PM, CT Laboratories, Inc.	SOP: PM003
Sample disposal	David A Berwanger, Laboratory Director, CT Laboratories, Inc. Eric T Korthals, Laboratory PM, CT Laboratories, Inc.	SOP: PM003

QAPP Worksheet #28.1: Analytical Quality Control and Corrective Action - Metals
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil, Sediment, Surface Water
Analytical Group: MC and Geochemical Metals
Analytical Group: Lead
Analytical Method/SOP: USEPA SW-846 Method 6010C Modified / SOPs: MT007 and MT009

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
Equipment Blank	1 per 20 field samples per matrix per sampling technique. (Not needed if disposable equipment is used)	All Target Compounds <1/2RL. Project QLs for all target compounds are specified in: Worksheets #15.1 and #15.2 for solid matrix.	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply U-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5×/10× rule.	Field Personnel / CB&I Chemist / Data Validator	Same as Method/SOP Acceptance Criteria
Field Duplicate	1 per 10 field samples per matrix	All Target Compounds: RPD≤35%.	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the method RL and the remaining pair is non-detect, then the data will be qualified as estimated "J" or rejected "R" depending upon the severity (i.e., >2RL).	Field Personnel / CB&I Chemist / Data Validator	Same as Method/SOP Acceptance Criteria
ICAL	ICAL prior to sample analysis.	If more than one calibration standard is used, r≥0.995. ICP: minimum one high standard and a calibration blank	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Analyst	Same as Method/SOP Acceptance Criteria
IS ICP Mass Spectrometry (ICPMS)	Every sample.	IS intensity within 30-120% of intensity of the IS in the ICAL (ICPMS).	Reanalyze sample at 5-fold dilution with addition of appropriate amounts of internal standards. Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria

QAPP Worksheet #28.1: Analytical Quality Control and Corrective Action - Metals
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
MS Tuning (ICPMS)	Prior to initial calibration	Mass calibration ≤0.1 amu from the true value; Resolution <0.9 amu full width at 10% peak height; For stability, RSD ≤ 5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions. Flagging criteria are not appropriate. No analysis shall be performed without a valid MS tune.	Analyst	Same as Method/SOP Acceptance Criteria
Linear dynamic range or High-level calibration check standard	Every 6 months	Within ± 10% of true value.	Not Applicable	Analyst	Same as Method/SOP Acceptance Criteria
Low-level calibration check standard	Daily, after one-point ICAL.	Within ± 20% of true value. Low-level calibration check standard should be less than or equal to the reporting limit.	Correct problem, then reanalyze. Flagging criteria are not appropriate. No samples may be analyzed without a valid low-level calibration check standard.	Analyst	Same as Method/SOP Acceptance Criteria
ICV (Second Source)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analyte(s) within ±10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Same as Method/SOP Acceptance Criteria
CCV	After every 10 field samples and at the end of the analysis sequence.	Within ± 10% of true value	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Same as Method/SOP Acceptance Criteria

QAPP Worksheet #28.1: Analytical Quality Control and Corrective Action - Metals
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)
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QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
Calibration blanks	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected >LOD. Project LODs for all target compounds are specified in: Worksheets #15.1 and #15.2 for solid matrix.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply U-flag to all results for specific analyte(s) in all samples associated with the blank.	Analyst	Same as Method/SOP Acceptance Criteria
MB	One per preparatory batch per matrix	No analytes detected >½LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project LOQs for all target compounds are specified in: Worksheets #15.1 and #15.2 for solid matrix.	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct the problem. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply U-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria
LCS	One LCS per preparatory batch per matrix	QC acceptance criteria specified by DoD, if available. QC acceptance criteria for all target compounds as specified in: Worksheet #12.1 for solid matrix.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria
MS[1]	One MS per preparatory batch per matrix	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS. QC acceptance criteria for all target compounds as specified in: Worksheet #12.1 for solid matrix. See Footnote 1.	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, additional QC tests are required to evaluate matrix effects. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria

QAPP Worksheet #28.1: Analytical Quality Control and Corrective Action - Metals
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)
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QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
MSD[1] or SDs	One per preparatory batch per matrix	MSD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. MSD or SD: RPD≤20% (between MS and MSD or sample and SD). QC acceptance criteria for all target compounds as specified in: Worksheet #12.1 for solid matrix. See Footnote 1.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference.	Analyst	Same as Method/SOP Acceptance Criteria
ICS (ICP/ICPMS only)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes <LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples. If corrective action fails, apply Q-flag to all results for specific analyte(s) in all samples associated with the ICS.	Analyst	Same as Method/SOP Acceptance Criteria
Serial Dilution Test (ICP/ICPMS only)	Each preparatory batch	Five-fold dilution must agree within ± 10%D of the original measurement. Only applicable for samples with concentrations >50× LOQ for ICP/ICPMS only.	Perform post-digestion spike (PDS) addition. Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria
PDS addition	When dilution test fails or analyte concentration in all samples <50× DL	Recovery within 75-125% of expected result. The spike addition should produce a level between 10× to 100× LOQ.	Run all associated samples in the preparatory batch by method of standard additions (MSA). For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Same as Method/SOP Acceptance Criteria
MSA or Internal Standard Cal.	When matrix interference is confirmed.	Document use of MSA in the case narrative.	Not Applicable	Analyst	Same as Method/SOP Acceptance Criteria
Results between LOD and LOQ	All positive results must be confirmed	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Same as Method/SOP Acceptance Criteria

Ref: *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV* (USEPA, 2007) and *DoD Quality Systems Manual for Environmental Laboratories, Final Version 5.0* (DoD, 2013).

[1] For lead analysis, 2010 confirmatory sample concentration averages ranged from 5 to 50 mg/kg at FTSW. Based on this, the lead MS spiking levels should be around 25 mg/kg.

QAPP Worksheet #28.2: Analytical Quality Control and Corrective Action - Explosives
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

Matrix: Soil, Sediment, Surface Water
Analytical Group: Explosives
Analytical Method/SOP: USEPA SW-846 Method 8330A Modified / SOP: SV010

QC Sample	Number / Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
Equipment Blank	1 per 20 field samples per matrix per sampling technique. (Not needed if disposable equipment is used)	All Target Compounds <1/2RL. Project QLs for all target compounds are specified in: Worksheets #15.1 and #15.2 for solid matrix.	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply U-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5×/10× rule.	Field Personnel / CB&I Chemist / Data Validator	Same as Method/SOP Acceptance Criteria
Field Duplicate	1 per 10 field samples per matrix	All Target Compounds: RPD≤50%.	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the method RL and the remaining pair is non-detect, then the data will be qualified as estimated "J" or rejected "R" depending upon the severity (i.e., >2RL).	Field Personnel / CB&I Chemist / Data Validator	Same as Method/SOP Acceptance Criteria
Soil drying procedure (for solid matrix only)	Each sample and batch LCS.	Laboratory must have a procedure to determine when the sample is dry to constant weight. Record date, time, and ambient temperature on a daily basis while drying samples.	Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria
Soil sieving procedure (for solid matrix only)	Each sample and batch LCS.	Weigh entire sample. Sieve entire sample with a 10 mesh sieve (This is a modification step for 8330A in lieu of 30 mesh). Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve.	Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria

QC Sample	Number / Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
Soil grinding procedure (for solid matrix IS 8330B only)	Initial demonstration	The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to <75 µm by passing representative portions of ground sample through a 200 mesh sieve (ASTM E11).	Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria
ICAL	ICAL prior to sample analysis as needed (see CCV passing criteria below)	Min. of 5 calibration standards with the lowest standard concentration at or below the RL. Once calibration curve or line is generated, the lowest calibration standard must be re-analyzed. The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear reg. is used, $r \geq 0.995$. If using internal standardization, RSD≤20% for 8330A RSD≤15% for 8330B.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria
RT window position establishment and verification for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift for position establishment. Each calibration verification standard for RT verification.	Position shall be set using the midpoint standard of the calibration curve or the value in the CCV run at the beginning of the analytical shift. Analyte shall be within established window for each calibration verification. Each analyte shall be within established window.	Correct problem, and then reanalyze all samples analyzed since the last acceptable retention time check. If they fail, redo ICAL and reset RT window. Flagging criteria are not appropriate for initial verification. For CCV, apply a Q-flag to all results for analytes outside the established window. No samples shall be run without a verified RT window at the initial verification.	Analyst	Same as Method/SOP Acceptance Criteria
ICV (Second Source)	Immediately following ICAL.	All analyte(s) and surrogates within ±15% of true value for 8330A and within ±20% of true value for 8330B.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria
CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ±15% for 8330A and within ±20% for 8330B of the expected value from the ICAL.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Analyst	Same as Method/SOP Acceptance Criteria

QC Sample	Number / Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
RT window width calculated for each analyte and surrogate	At method set-up and after major maintenance (e.g., column change)	RT width is ± 3 times standard deviation for each analyte RT from 72-hour study.	Correct problem, then rerun ICAL. Flagging criteria are not appropriate.	Analyst	Same as Method/SOP Acceptance Criteria
MB and GB	MB: One per preparatory batch per matrix GB: One per prep batch (for solid matrix IS 8330B Sample only)	No analytes detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheets #15.3 and #15.4 for explosives for solid matrix.	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct the problem. Any sample associated with a blank that fail these criteria checks shall be reprocessed in a subsequent preparation batch, except when the sample analysis resulted in a non-detect. If no sample volume remains for reprocessing, the results shall be reported with appropriate data qualifying code "U."	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria
LCS	One LCS per preparatory batch per matrix	A solid reference material containing all reported analytes must be prepared (e.g., ground and sub-sampled) and analyzed in exactly the same manner as a field sample. In-house laboratory control limits for the LCS must demonstrate the laboratory's ability to meet the project's measurement quality objectives. QC acceptance criteria for all target compounds as specified in: Worksheet #12.2 for explosives for solid matrix.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria
MS[1]	One MS per preparatory batch per matrix	For matrix evaluation only; therefore, it is taken post grinding from same ground sample as parent subsample is taken. %R must meet LCS limits. QC acceptance criteria for all target compounds as specified in: Worksheet #12.2 for explosives for solid matrix.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria

QAPP Worksheet #28.2: Analytical Quality Control and Corrective Action - Explosives
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

QC Sample	Number / Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
MSD[1] or SD	One MSD or SD per preparatory batch per matrix	For matrix evaluation only; therefore, it is taken post grinding from same ground sample as parent subsample is taken. %R must meet LCS limits and RPD≤30%. QC acceptance criteria for all target compounds as specified in: Worksheet #12.2 for explosives for solid matrix.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference.	Analyst	Same as Method/SOP Acceptance Criteria
Surrogate Spikes	All field and QC samples	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. QC acceptance criteria for all target compounds as for soils: 1,2-Dinitrobenzene (74-128%)	For QC and field samples, correct problem then re-prep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met. Alternative surrogates are recommended when there is obvious chromatographic interference.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria
Quantitation Verification and Confirmation	When target analytes are detected on the primary column using the ultraviolet (UV) Detector (HPLC) at concentrations exceeding the LOD. Confirmation analysis is not needed if liquid chromatography/ mass spectrometry (LC/MS) or liquid chromatography/ tandem mass spectrometry (LC/MS/MS) was used for the primary analysis.	Calibration and QC criteria are the same as for initial or primary column analysis. Results between primary and second column RPD≤40%.	Report from both columns. If there is a > 40% RPD between the two column results, data must be J-flagged accordingly. Secondary column – Must be capable of resolving (separating) all of the analytes of interest and must have a different retention time order relative to the primary column. Any HPLC column used for confirmation analysis must be able to resolve and quantify all project analytes. Detection by HPLC UV, LC/MS or LC/MS/MS. Calibration and calibration verification acceptance criteria is the same as for the primary analysis.	Analyst	Same as Method/SOP Acceptance Criteria

QAPP Worksheet #28.2: Analytical Quality Control and Corrective Action - Explosives
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)
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QC Sample	Number / Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
Soil sample triplicate	Not required for this scope. If needed for IS 8330B sample only, at the sub-sampling step, one sample per batch. Cannot be performed on any type of blank sample.	Three 10 gram subsamples are taken from a sample expected to contain the highest levels of explosives within the quantitation range of the method. The RSD for results above the RL must not exceed 20%.	Corrective action must be taken if this criterion is not met (e.g., the grinding process should be investigated to ensure that the samples are being reduced to a sufficiently small particle size). Apply J-flag if corrective action does not solve problem and no sample available.	Analyst	Same as Method/SOP Acceptance Criteria
Results reported between LOD and LOQ	All positive results between LOD and LOQ	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Same as Method/SOP Acceptance Criteria

Ref: *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV* (USEPA, 2007) and *DoD Quality Systems Manual for Environmental Laboratories, Final Version 5.0* (DoD, 2013).

[1] For explosives analysis, 2010 confirmatory sample concentrations were all non-detect; therefore, based on this the explosives MS spiking levels will be at normal spiking levels of around 2 mg/kg.

Matrix: Soil, Sediment, Surface Water
Analytical Group: TOC and pH
Analytical Method/SOP: USEPA Lloyd Kahn / SOP: WC040; SW-846 9060A / SOP: WC039; USEPA SW-846 Method 9045D / SOP: WC021; and SW-846 9045D / SOP: WC021

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
ICAL	Daily ICAL prior to sample analysis	TOC: Minimum of 3 standards and a calibration blank. r≥0.995. pH: Calibrate the meter using two points, pH 4 and pH 7 or pH 4 and pH 10.	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed.	Analyst	Same as Method/SOP Acceptance Criteria
ICV	Once after each ICAL, prior to beginning a sample run.	TOC: Within ±10% of true value. pH: The third standard not used in ICAL should be within ±0.05 of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Same as Method/SOP Acceptance Criteria
CCV	After every 10 field samples and at the end of the analysis sequence.	TOC: Within ±10% of true value. pH: The third standard not used in ICAL should be within ±0.05 of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Same as Method/SOP Acceptance Criteria
MB	One per preparatory batch per matrix	TOC: No analytes detected >½LOQ. Blank result must not otherwise affect sample results. Project LOQs for all target compounds are specified in: Worksheets #15.5 and #15.6 for TOC for solid matrix. pH: Not Applicable	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct problem. If required, re-prep and reanalyze MB and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply U-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid MB. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria

QAPP Worksheet #28.3: Analytical Quality Control and Corrective Action - TOC and pH
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
LCS	One LCS per preparatory batch per matrix	TOC: QC acceptance criteria specified by DoD, if available. QC acceptance criteria for all target compounds as specified in: Worksheet #12.3 for TOC for solid matrix. pH: Not Applicable	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria
MS	One MS per preparatory batch per matrix. No project specific sample MS required.	pH and TOC: Not Applicable	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, additional QC tests are required to evaluate matrix effects. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Same as Method/SOP Acceptance Criteria
MSD or SD	One per preparatory batch per matrix. No project specific sample MSD or SD required	TOC SD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. RPD≤20% (between MS and MSD or sample and SD). QC acceptance criteria for all target compounds as specified in: Worksheet #12.3 for TOC for solids pH: Not Applicable	Correct problem and reanalyze sample and duplicate. Apply J-flag if sample cannot be rerun or reanalysis does not correct problem. The data shall be evaluated to determine the source of difference.	Analyst	Same as Method/SOP Acceptance Criteria

QAPP Worksheet #28.3: Analytical Quality Control and Corrective Action - TOC and pH
(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6) (EPA 2106-G-05 Section 2.3.5)

QC Sample	Number/Frequency	Method/SOP Acceptance Criteria	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific Measurement Performance Criteria
Results reported	Quadruplicate analysis, if required. (TOC Only)	Report the average and the range (TOC only).	Not Applicable	Analyst	Same as Method/SOP Acceptance Criteria
Results reported between LOD and LOQ	All positive results must be confirmed	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Same as Method/SOP Acceptance Criteria

Ref: *EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV* (USEPA, 2007) and *DoD Quality Systems Manual for Environmental Laboratories, Final Version 5.0* (DoD, 2013).

QAPP Worksheet #29: Project Documents and Records
(UFP-QAPP Manual Section 3.5.1) (EPA 2106-G-05 Section 2.2.8)
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Record	Generation	Verification	Storage Location/Archival
Project Planning Documents:			
Work Plan	Emily Tucker - CB&I Technical Lead	Alex Smith - CB&I PM; Bill Dickson, CB&I UXOSO and UXOQCS;	CB&I Project File and Computer Server; Belcamp, MD
UFP-QAPP	Eric Malarek - CB&I Project Chemist; Emily Tucker - CB&I Technical Lead	Alex Smith - CB&I PM; Bill Dickson, CB&I UXOSO and UXOQCS;	CB&I Project File and Computer Server; Belcamp, MD
H&S Plan	Emily Tucker - CB&I Technical Lead	Alex Smith - CB&I PM; Bill Dickson, CB&I UXOSO and UXOQCS;	CB&I Project File and Computer Server; Belcamp, MD
Accident and Prevention Plan	Emily Tucker - CB&I Technical Lead	Alex Smith - CB&I PM; Bill Dickson, CB&I UXOSO and UXOQCS;	CB&I Project File and Computer Server; Belcamp, MD
Sample Collection and Field Records:			
Field / Communication Logbooks and/or Log Sheets	Emily Tucker - CB&I MC Sampling Lead; Jeremy Flemmer - CB&I Project Geophysicist; Bill Dickson - CB&I UXOSO; David Coe - CB&I SUXOS	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Field Personnel Accountability Sign-in Log	Emily Tucker - CB&I MC Sampling Lead; Jeremy Flemmer - CB&I Project Geophysicist; Bill Dickson - CB&I UXOSO; David Coe - CB&I SUXOS	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Daily Tailgate Safety Meeting Form	Emily Tucker - CB&I MC Sampling Lead; Jeremy Flemmer - CB&I Project Geophysicist; Bill Dickson - CB&I UXOSO; David Coe - CB&I SUXOS	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Job Safety Analysis Form	Emily Tucker - CB&I MC Sampling Lead; Jeremy Flemmer - CB&I Project Geophysicist; Bill Dickson - CB&I UXOSO; David Coe - CB&I SUXOS	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Visitor’s Log	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Site Maps with Sampling Locations	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Field Equipment Calibration Forms	Emily Tucker - CB&I MC Sampling Lead; Jeremy Flemmer - CB&I Project Geophysicist; David Coe - CB&I SUXOS	Alex Smith - CB&I PM; Bill Dickson, CB&I UXOSO and UXOQCS;	CB&I Project File and Computer Server; Belcamp, MD
Sample Collection Logs	Emily Tucker - CB&I MC Sampling Lead	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Chain-of-Custody Records	Emily Tucker - CB&I MC Sampling Lead	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Custody Seals	Emily Tucker - CB&I MC Sampling Lead	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD

Record	Generation	Verification	Storage Location/Archival
Sample Collection and Field Records (Continued):			
Air Bill Records	Emily Tucker - CB&I MC Sampling Lead	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Project Assessments:			
Daily QC Report	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOQCS	Alex Smith - CB&I PM; Bill Dickson, CB&I UXOSO	CB&I Project File and Computer Server; Belcamp, MD
Field Audit Checklists (If performed)	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOQCS	Alex Smith - CB&I PM; Bill Dickson, CB&I UXOSO	CB&I Project File and Computer Server; Belcamp, MD
Data Validation Reports	Eric Malarek - CB&I Project Chemist	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Data Usability Assessment Reports	Eric Malarek - CB&I Project Chemist	Alex Smith - CB&I PM	CB&I Project File and Computer Server; Belcamp, MD
Laboratory Records:			
Laboratory Certifications and Accreditations	Christelle Newsome - CT Labs QAO	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD
Laboratory QA Manual	Christelle Newsome - CT Labs QAO	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD
Laboratory SOPs	Christelle Newsome - CT Labs QAO	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD
Sample Receipt Confirmation Forms	Eric T Korthals - CT Labs PM	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD
Data Summary Reports (Form 1 Data)	Eric T Korthals - CT Labs PM	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD
Data Packages (See Laboratory Data Deliverables)	Eric T Korthals - CT Labs PM	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD
Electronic Data Deliverables (See Laboratory Data Deliverables)	Eric T Korthals - CT Labs PM	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD
Sample Disposal Records	Eric T Korthals - CT Labs PM	Eric Malarek - CB&I Project Chemist	CB&I Project File and Computer Server; Belcamp, MD

QAPP Worksheet #29: Project Documents and Records
(UFP-QAPP Manual Section 3.5.1) (EPA 2106-G-05 Section 2.2.8)

Laboratory Data Deliverables (Submitted as PDF and Excel Files as applicable):

Record	MC and Geochemical Metals	Lead	Explosives	TOC	pH
Case Narrative Noting Any Non-Conformance Records	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Laboratory Information Management System (LIMS) Login Forms With Lab and Field ID Cross References	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Reporting Checklists - For Completeness	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Chain-of-Custody Records with Signature Sign-Offs	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Internal Sample Tracking Forms (Sample Chronology)	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Result Summary Forms	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Definitions Of Laboratory Data Qualifiers	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
QC Sample Summaries (Blanks, Duplicates, MS/MSD, LCS, Etc.)	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Instrument Calibration Logs	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Sample and QC Raw Data	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Extraction and Prep Logs	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
Standard Prep Logs	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]
CB&I EQUIS Electronic Data Deliverables	TBD[1]	TBD[1]	TBD[1]	TBD[1]	TBD[1]

[1] To Be Determined (TBD): No significant MC releases are anticipated at the FTSW Site. Sampling for MC and Geochemical metals, lead, explosives, TOC, or pH may be implemented at specific locations within any discovered impact areas where physical evidence suggesting a potential release of MC is observed during intrusive investigations or other RFI activities. The locations and number of samples (including QC samples) to be analyzed will be determined following completion of the MEC investigation in conjunction with the Project Delivery Team based on the results of the surface surveys. No MC sampling is planned. If needed, the locations, field QC, and methods are proposed in Worksheet #18.

QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action
(UFP-QAPP Manual Sections 4.1.1 and 4.1.2) (EPA 2106-G-05 Section 2.4 and 2.5.5)

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Review of UFP-QAPP and Work Plan with Field Staff	Alex Smith - CB&I PM; Bill Dickson - CB&I UXOSO	1/prior to sampling startup	11/2014	UFP QAPP and Work Plan	11/2014
Daily QC Report	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOQCS	Daily	11/2014 to 1/2015 for Field Activities	Daily QC Report	11/2014 to 1/2015 for Field Activities
Laboratory Assessment for Appropriate Certifications, Capacity and UFP-QAPP Review with Staff	Eric Malarek - CB&I Project Chemist Eric T Korthals - CT Labs PM	1/prior to sampling startup	03/2014	Laboratory Scope of Work and Request for Proposal	03/2014
Daily Tailgate Safety Meeting	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO and UXOQCS; David Coe - CB&I SUXOS	Daily	11/2014 to 1/2015 for Field Activities	Tailgate Safety Form	11/2014 to 1/2015 for Field Activities
Job Safety Analysis	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO and UXOQCS; David Coe - CB&I SUXOS	Daily	11/2014 to 1/2015 for Field Activities	Job Safety Analysis Form	11/2014 to 1/2015 for Field Activities
Field Sampling and COC Review Against UFP-QAPP Requirements	Eric Malarek - CB&I Project Chemist Eric T Korthals - CT Labs PM	Daily	11/2014 to 1/2015 for Field Activities	COC and Lab Login Sheet	11/2014 to 1/2015 for Field Activities
Laboratory Report Deliverables and Analytical Results Against UFP-QAPP Requirements Data Verification	Eric Malarek - CB&I Project Chemist Eric T Korthals - CT Labs PM	Per Sample Delivery Group	12/2014 to 03/2015 for Lab Analysis	Laboratory Data Packages and EDDs	12/2014 to 03/2015 for Lab analysis

QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action
(UFP-QAPP Manual Sections 4.1.1 and 4.1.2) (EPA 2106-G-05 Section 2.4 and 2.5.5)

Assessment Response and Corrective Action:

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for Monitoring
Review of UFP-QAPP and Work Plan with Field Staff	Alex Smith - CB&I PM Bill Dickson - CB&I UXOQCS	Contained with written Daily QC Report for that day with corrective action.	Immediate	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO	Alex Smith - CB&I PM
Daily QC Report	Alex Smith - CB&I PM Bill Dickson - CB&I UXOQCS	Daily QC Report would be amended with corrective action.	Immediately, not to exceed 24 hours	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO	Alex Smith - CB&I PM UXOQCS, CB&I
Laboratory Assessment for Appropriate Certifications, Capacity and UFP-QAPP Review with Staff	Christelle Newsome- CT Labs QAO David A Berwanger - CT Labs Lab Director	Laboratory Scope of Work	Immediate	Christelle Newsome- CT Labs QAO David A Berwanger - CT Labs Lab Director	Alex Smith - CB&I PM; Eric Malarek - CB&I Project Chemist
Daily Tailgate Safety Meeting	Alex Smith - CB&I PM; David Mummert - CB&I H&S CIH	Tailgate Safety Form	Immediately, not to exceed 24 hours	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO	Alex Smith - CB&I PM; CB&I H&S
Job Safety Analysis	Alex Smith - CB&I PM; David Mummert - CB&I H&S CIH	Job Safety Analysis Form	Immediately, not to exceed 24 hours	Emily Tucker - CB&I MC Sampling Lead; Bill Dickson - CB&I UXOSO	Alex Smith - CB&I PM; CB&I H&S
Field Sampling and COC Review Against UFP-QAPP Requirements	Eric T Korthals - CT Labs PM David A Berwanger - CT Labs Lab Director	COC; Communication may be in the form of email traffic.	24 hours after sampling	Eric T Korthals - CT Labs PM David A Berwanger - CT Labs Lab Director	Alex Smith - CB&I PM; Eric Malarek - CB&I Project Chemist
Laboratory Report Deliverables and Analytical Results Against UFP-QAPP Requirements Data Verification	Eric T Korthals - CT Labs PM David A Berwanger - CT Labs Lab Director	Laboratory Data Packages and EDDs; Communication may be in the form of email traffic.	24 hours after completion of analytical work	Eric T Korthals - CT Labs PM David A Berwanger - CT Labs Lab Director	Alex Smith - CB&I PM; Eric Malarek - CB&I Project Chemist

QAPP Worksheet #34: Data Verification and Validation Inputs
(UFP-QAPP Manual Section 5.2.1 and Table 9) (EPA 2106-G-05 Section 2.5.1)

Item	Description	Verification (completeness)	Data Validation (conformance to specifications)
Planning Documents/Records:			
1	Work Plan	X	
2	UFP-QAPP	X	
3	H&S Plan	X	
4	Accident and Prevention Plan	X	
5	Contract	X	
6	Field SOPs	X	
7	Laboratory SOPs	X	
8	Laboratory Quality Assurance Manual (QAM)	X	
9	Laboratory Certifications and Accreditations	X	
10	OSHA 40/8hr Training Records	X	
11	OSHA Site Safety Officer Training Records	X	
12	DDESB TP 18 Qualification Records	X	
13	Permits	X	
Field Records:			
14	Field Logbooks	X	X
15	Relevant Communication Records (Field Progress Reports)	X	X
16	Field Equipment Calibration Records	X	X
17	Chain-of-Custody Forms	X	X
18	Sampling Diagrams/Surveys	X	X
19	Field Sample Collection Log Sheets	X	X
20	Daily QC Report and Corrective Action Reports	X	X
21	Daily Tailgate Safety Meeting	X	X
22	Job Safety Analysis	X	X

QAPP Worksheet #34: Data Verification and Validation Inputs
(UFP-QAPP Manual Section 5.2.1 and Table 9) (EPA 2106-G-05 Section 2.5.1)

Item	Description	Verification (completeness)	Data Validation (conformance to specifications)
Analytical Data Package and Electronic Data Deliverables:			
23	Cover Sheet (Lab Identifying Information)	X	X
24	Case Narrative and Corrective Action Reports	X	X
25	Relevant Communication Records	X	X
26	Internal Chain-of-Custody Forms	X	X
27	Sample Receipt Records	X	X
28	LOD/LOQ Verification	X	X
29	Standards Traceability	X	X
30	Result Summary Forms	X	X
31	Definitions Of Laboratory Data Qualifiers	X	X
32	QC Sample Summaries (Blanks, Duplicates, MS/MSD, LCS, Etc.)	X	X
33	Instrument Calibration Records and Logs	X	X
34	Sample and QC Raw Data	X	X
35	Extraction and Prep Logs (Date and Time)	X	X
36	Run Logs (Instrument, Date, and Time)	X	X
37	Standard Prep Logs (Date and Time)	X	X
38	Quantitation Verification	X	X
39	CB&I EQUIS Electronic Data Deliverables	X	X
40	Environmental Restoration Information System (ERIS) Electronic Data Deliverables	X	X

QAPP Worksheet #35: Data Verification Procedures
(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
MEC Characterization and Accountability	• Meet all requirements as specified in the DDESB TP 18 Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel (DDESB, 2004, Table 4-1).	All field staff training requirements will be verified prior to field activities. Graduate of the EOD School of the United States, Canada, Great Britain, Germany, or Australia. Graduate of a formal training course of instruction or EOD assistant courses.	Bill Dickson / CB&I Alex Smith / CB&I
Field Staff Training[1]	• 40-Hour Hazardous Waste Site Worker (All Field Staff) • 8-Hour Hazardous Waste Site Worker Annual Refresher (All Field Staff) • 8-Hour Hazardous Waste Site Supervisor Training (Field Lead Only) • 50-Hour Site Safety Officer Training including 10-Hour OSHA Construction Site Worker Safety Training (Site Safety and Health Officer Only)	All field staff training requirements will be verified prior to field activities. Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. This includes but is not limited to basic sampling techniques; field testing methodology, task-specific sampling methods, maintenance of environmental paperwork, and how to avoid cross contamination. In addition to education and experience, specific training may be required to qualify individuals to perform certain activities. Training will be documented appropriately and the forms placed in the project file as a record. Training of field personnel will be provided by the SUXOS, UXOQCS, Field Lead, or by a qualified designee.	Emily Tucker / CB&I Bill Dickson / CB&I Alex Smith / CB&I Eric Malarek / CB&I
Laboratory Staff Training	• Laboratory Training Records	Laboratory senior management staff retains oversight responsibility for the data integrity program and retains the ultimate responsibility for execution of the data integrity program elements. Senior laboratory management staff is responsible for providing the resources required to conduct SOPs, ethics training, and operate data integrity evaluation procedures. Laboratory employees receive technical ethics training during new employee orientation. All employees are required to attend ethics refresher training and to sign an ethical conduct agreement annually, which verifies their understanding of the laboratory's ethics policy and the analyst's ethical responsibilities. Training on data integrity procedures and SOPs are conducted by the individual departments' group leaders within the laboratory. All records of training are retained at the laboratory in the individual staff training folders and are maintained by the Laboratory QAO. All information related to staff qualifications, experience, external training courses, and education are placed into the individual's training file. Verification documentation for laboratory orientation, H&S, and QA training is also maintained with the training file. Additional training documentation is added to the files as it occurs. This includes data for initial and continuing demonstrations of proficiency, performance evaluations, study data and notes, and attendance lists from individual and group training sessions.	David A Berwanger / CT Labs Christelle Newsome / CT Labs

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Planning Documents	• Work Plan • UFP-QAPP • H&S Plan • Accident and Prevention Plan	Copies of the reviewed and approved versions of the planning documents will be made available by the Field Lead to all CB&I personnel involved in this project. The laboratory will be provided a copy of the UFP-QAPP by the Project Chemist for review. Project personnel will receive an orientation to the UFP-QAPP, Work Plan, and the Accident Prevention Plan as appropriate to their responsibilities before participation in project activities. All field and laboratory work performed will be reviewed against the planning documents as part of the verification and validation processes for completeness and accuracy. The CB&I PM and the Field Lead are responsible for ensuring that all staff have reviewed the final UFP-QAPP.	Emily Tucker / CB&I Bill Dickson / CB&I Alex Smith / CB&I Eric Malarek / CB&I Christelle Newsome / CT Labs
Laboratory Documents	• Laboratory QAM • Certifications and Accreditations	The Laboratory QAM and Accreditations were reviewed and verified during the laboratory selection process. CT Laboratories, Inc. (CT Laboratories, Inc. Quality Manual Effective Date 03/28/2014 Revision #15.1) has a detailed QAM that is designed to meet the quality program requirements of to assure compliance with the 2003 NELAC standards and 2005 ISO/IEC Guide. The QAM may be found in **Attachment 2**. CT Laboratories, Inc. has current ELAP accreditation (#3317.01; Exp. 06/30/2014) compliant with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD ELAP as detailed in the DoD QSM V5.0.	Eric Malarek / CB&I Christelle Newsome / CT Labs
Field Logbooks	• Field Logbooks • Field Log Sheets	The sample number will be traceable to the site, location, and depth (where applicable). The sample identification and description will be recorded by the Field Lead in the sample collection logbook/log sheets. The Field Lead will perform daily reviews of field logbooks/log sheets each day of sampling to include: • Verify that records are present and complete for each day of field activities • Verify that all planned samples including field QC samples were collected and that sample collection locations are documented • Verify that meteorological data were provided for each day of field activities • Verify that changes/exceptions are documented and were reported in accordance with requirements • Verify that any required field monitoring was performed and results are documented	Emily Tucker / CB&I
Daily Field Progress Reports	• Daily Field Progress Reports • Corrective Action Reports	Field Lead will provide daily reports to the CB&I PM via phone, fax, or e-mail.	Emily Tucker / CB&I

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Sample Location Verification	• Field Logbooks • Sampling Diagrams/Surveys • UFP-QAPP	The Field Lead will verify that the samples were collected from the proper locations and depths as described in Worksheet #18 and any sampling diagrams.	Emily Tucker / CB&I
Chain-of-Custody – Field Level	• Chain-of-Custody	The Field Lead will complete the COC form during field sampling in accordance with the sample matrices and analytical tests required as described in Worksheet #19. Prior to placement in the cooler, the Field Lead will review the COC form against the field logbooks/log sheets and Worksheets #18 and #19 to ensure that the samples, sample volumes, preservatives, turnaround time, and sample nomenclature match and the required analytical tests have been notated. A review of the COC form for completeness will also be conducted.	Emily Tucker / CB&I
Laboratory LIMS Login Receipt	• Laboratory Login Sample Receipt Records • Chain-of-Custody • UFP-QAPP	The laboratory will provide within 48 hours of receipt of samples a copy of the sample receipt form. A review by the laboratory PM of the COC form against the laboratory LIMS login and the project analytical requirements as contained in Worksheet #18 will be conducted to ensure that the login is correct and the proper analytical tests have been assigned. A secondary review by the Project Chemist of the COC form against the laboratory LIMS login and the project analytical requirement as contained in Worksheet #18 will be conducted to ensure that the login is correct and the proper analytical tests have been assigned. Any discrepancies between the COC and the sample containers will be noted and contained as part of the analytical record.	Eric Malarek / CB&I Eric T Korthals / CT Labs
Laboratory Corrective Action and Report Procedure	• Case Narrative and Corrective Action Reports and E-mails	Routine corrective action is defined as procedures used to return out of control analytical systems back to control. This level of corrective action applies to all analytical QC parameters and analytical system specification as defined in the laboratory SOPs. Bench analysts have full responsibility and authority for performing routine corrective action. Routine corrective actions are documented as part of the analytical record. Defective processes, holding time violations, systematic errors and quality defects that occur are to be reported by the bench chemist immediately to the section supervisor and a nonconformance record initiated. The section supervisor will notify the designated Laboratory PM who will then notify the CB&I Project Chemist. All notifications must be made in a timely manner. The nonconformance record should become part of the analytical record.	David A Berwanger / CT Labs Christelle Newsome / CT Labs Eric T Korthals / CT Labs Eric Malarek / CB&I

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Analytical Data Package	• Analytical Data Package	All data produced by the laboratory will be required to undergo several levels of review, which will include two levels of management review at the laboratory. The laboratory will review the data packages internally for completeness and verify that all of the required forms and raw data are included for each data package type. Random data packages may be chosen by the Laboratory QAO for additional audits. The CB&I Project Chemist will verify that data have been received for all samples that have been sent to the laboratory. An evaluation of these data will be performed to determine whether the laboratory met the QC requirements as stated in the analytical methods and laboratory SOPs. Refer to Worksheets #12, #19, and #28.	David A Berwanger / CT Labs Christelle Newsome / CT Labs Eric T Korthals / CT Labs Eric Malarek / CB&I
Laboratory Electronic Data Deliverables (EDDs)	• CB&I EQUIS EDD • ERIS EDD	The laboratory will provide source EDDs in CB&I EQUIS formats that have been generated by the laboratory's LIMS. The Project Chemist will review these files for correctness and completeness. The laboratory will include the EQUIS EDDs for each analytical batch on CD. The laboratory will address via a brief explanation in the Non-Conformance Log any non-conformance that is not within their control. The final laboratory non-conformance report and results shall be provided to the project chemist and data validator to expedite the validation process and the validation qualifier fields populated. The EQUIS EDDs will facilitate the data evaluation and validation process and will be used to generate the appropriate ERIS transfer files for upload of the data into the ERIS data depository (by CB&I). Data validation qualifiers will be populated for each sample/analyte into the source EDDs by the Validator (as applicable) and then verified by the Project Chemist. Once verified, the EDDs will be used for the precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) analysis performed by the Project Chemist as described in Worksheet #37 to access the data usability. Any QC issues that may impact the data use will be evaluated. In cases of multiple runs for each sample from sample dilutions and/or re-analysis, a "best fit" data file will be generated by the Project Chemist for final use. The best fit data will be made available for table generation for the final report and data comparisons to screening criteria in Worksheet #15. The validation report and EDD turnaround time is 30 calendar days from data package receipt.	David A Berwanger / CT Labs Christelle Newsome / CT Labs Eric T Korthals / CT Labs Eric Malarek / CB&I

[1] Training records and/or certificates will be available on-site or in-person.

QAPP Worksheet #36: Data Validation Procedures
(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Data Validator: CB&I					
Analytical Group/Method:	MC and Geochemical Metals: USEPA SW-846 6010C	Lead: USEPA SW-846 6010C	Explosives: USEPA SW-846 8330A Modified	TOC: USEPA Lloyd Kahn	pH: USEPA SW-846 9045D
Data deliverable requirements:	Stage 4 (Contract Laboratory Program [CLP] Like)	Stage 4 (CLP Like)	Stage 4 (CLP Like)	Stage 2	Stage 2
Analytical specifications:					
Measurement performance criteria:	See Worksheet #12.1	See Worksheet #12.1	See Worksheet #12.2	See Worksheet #12.3	See Worksheet #12.3
Percent of data packages to be Verified (completeness):	100%	100%	100%	100%	100%
Percent of data packages to be validated:	100%	100%	100%	0%	0%
Percent of raw data reviewed:	100%	100%	100%	0%	0%
Percent of results to be recalculated:	5%	5%	5%	0%	0%
Verification procedure:	The limited verification effort to assess laboratory performance will include a review of: completeness, COC, holding times, QC results reported on summary forms (LCS, MBs, MS/MSD, and serial dilutions), detection and reporting limits, and other contractual items.				
Validation procedure:	The data validation will cover the analysis of the QC evaluation of the data of each analytical run and test according to the project and method criteria and application of any validation qualifiers (if required). This includes detailed evaluations of the data such as calibrations, calibration check standards, quantitation verifications, instrument tunes, interference check samples, surrogates, MS/MSD, LCS, method and calibration blanks, holding times, and preservation. Data will be validated in accordance with criteria as specified in Worksheets #12, #15, #19, and #28 which is based upon: • *DoD Quality Systems Manual for Environmental Laboratories, Final Version 5.0* (DoD, 2013) • Cited EPA SW-846 methodology			Only Data Verification will be performed for soil indicator parameters.	
Validation code (See following table):	*EPA National Functional Guidelines for Superfund Inorganic Data Review, EPA 540-R-10-011* (USEPA, 2010)	*EPA National Functional Guidelines for Superfund Inorganic Data Review, EPA 540-R-10-011* (USEPA, 2010)	*EPA National Functional Guidelines for Superfund Organic Data Review, EPA 540-R-08-01* (USEPA, 2008)	NA	NA
Electronic validation program/version:	CB&I EQUIS	CB&I EQUIS	CB&I EQUIS	CB&I EQUIS	CB&I EQUIS

QAPP Worksheet #36: Data Validation Procedures
(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Validation Code[1]	Definition
R	Unreliable result. Analyte may or may not be present in the sample. Supporting data necessary to confirm result.
B	Not detected substantially above the level of the reported in laboratory or field blanks.
J	Analyte present. Reported value may not be accurate or precise.
UJ	Not detected, quantitation limit may be inaccurate or imprecise.
N	Tentative Identification. Consider present. Special methods may be to confirm its presence or absence in future sampling efforts.
NJ	Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity.
K	Analyte present. Reported value may be biased high. Actual value is expected to be lower.
L	Analyte present. Reported value may be biased low. Actual value is expected to be higher.
UL	Not detected, quantitation limit is probably higher.
Reason Code	**Definition**
01	Sample received outside of 4+/-2 degrees Celsius
01A	Improper sample preservation
02	Holding time exceeded
02A	Extraction
02B	Analysis
03	Instrument performance – outside criteria
03A	BFB
03B	DFTPP
03C	DDT and/or Endrin % breakdown exceeds criteria
03D	Retention time windows
03E	Resolution
04	Initial calibration results outside specified criteria
04A	Compound mean RRF QC criteria not met
04B	Individual % RSD criteria not met
04C	Correlation coefficient >0.995
05	Continuing calibration results outside specified criteria
05A	Compound mean RRF QC criteria not met
05B	Compound % D QC criteria not met
06	Result qualified as a result of the 5×/10× blank correction
06A	Method or preparation blank
06B	ICB or CCB
06C	ER or RB
06D	TB
06E	FB
07	Surrogate recoveries outside control limits
07A	Sample
07B	Associated method blank or LCS

QAPP Worksheet #36: Data Validation Procedures
(UFP-QAPP Manual Section 5.2.2) (EPA 2106-G-05 Section 2.5.1)

Reason Code	Definition
08	MS/MSD/Duplicate results outside criteria
08A	MS and/or MSD recovery not within control limits (accuracy)
08B	% RPD outside acceptance criteria (precision)
09	PDS outside criteria (GFAA)
10	Internal standards outside specified control limits
10A	Recovery
10B	Retention time
11	Laboratory control sample recoveries outside specified limits
11A	Recovery
11B	% RPD (if run in duplicate)
12	Interference check standard
13	Serial dilution
14	Tentatively identified compounds
15	Quantitation (Value reported <LOQ and >DL)
16	Multiple results available; alternate analysis preferred
17	Field duplicate RPD criteria is exceeded
18	Percent difference between original and second column exceeds QC criteria
19	Professional judgment was used to qualify the data
20	Pesticide cleanup checks
21	Target compound identification
22	Radiological calibration
23	Radiological quantitation
24	Reported result and/or lab qualifier revised to reflect validation findings

[1] The USEPA data validation qualifiers are referenced from *Region III Modifications to the National Functional Guidelines for Organic Data Review* (September 1994). The listed data qualifiers will be applied during data validation. Potential impacts on project-specific DQOs will be discussed in the data validation report and data usability assessment.

QAPP Worksheet #37: Data Usability Assessment
(UFP-QAPP Manual Section 5.2.3 including Table 12)
(EPA 2106-G-05 Sections 2.5.2, 2.5.3, and 2.5.4)

Identify personnel (organization and position/title) responsible for participating in the data usability assessment:	
Project Manager	Alex Smith, CB&I
Project Technical Lead	Emily Tucker, CB&I
Project MC Sampling Lead	Emily Tucker, CB&I
Project Geophysicist	Jeremy Flemmer, CB&I
Project Chemist	Eric Malarek, CB&I
Data Manager	Randy Dameron, CB&I
Ecological Risk Assessor	Mark Weisburg, CB&I
Human Health Risk Assessor	Paul Goetchius, CB&I

Describe how the usability assessment will be documented:
The following steps describe the documentation and processes that will be used during the usability assessment and notes how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies. The general review process is described in CB&I SOP EI-FS020. Field data generated by the field personnel is initially reviewed, processed, and evaluated on site by the technical lead, task manager, and/or his/her designee. Copies of the original forms are maintained on site for reference, and the originals are then forwarded to the data coordinator for further review, inclusion into the project database, and final storage in the project central files.

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:	
Step 1: Review the project's objectives and sampling design	Review the key outputs defined during systematic planning (i.e., PQOs or DQOs and Measurement Performance Criteria) to make sure they are still applicable. Review the sampling design for consistency with stated objectives. This provides the context for interpreting the data in subsequent steps. Project Objective: The overall objective of this work is to conduct an RFI to define the nature and extent of MEC and MC and, if present, determine the risks of the MC constituents for FTSW Area MMRP MRS sites: FTSW-009-R-01: Anti-Aircraft Range - 4A; FTSW-009-R-02: Anti-Aircraft Range - 4B; FTSW-010-R-01: Anti-Tank Range 90-MM-2; and FTSW-011-R-01: Grenade Launcher Range. The investigation may be extended if items are identified near site boundaries, however, the investigation will not extend into the operational range. As stated in Worksheet #10, there are no known sources of MC at any of the MRSs based on Phase 2 CS sampling. However, a potential MC release could be encountered during the RFI MEC investigation if exposed fillers, a DMM pit, or previously unknown small arms berm is discovered. It should be noted that additional field investigations at Anti-Aircraft Range - 4A will not be conducted as sufficient coverage has been obtained during previous investigations. If a DMM pit or other potential MC release is identified during the RFI for MEC, assess and delineate the nature and extent of MC and determine if there is unacceptable risk to human health or the environment. The RFI will accomplish the following objectives: • Determine nature and extent of MEC • Determine nature and extent of MC (if required) • Determine the hazard and risk posed to human health and the environment by MEC and MC • Utilize the RFI data to determine if further response is required pursuant to RCRA Discrete Sampling Design: Based on previous investigations at similar ranges, unacceptable MC risk is not anticipated unless there are high concentrations of MEC with exposed fillers, burial pits containing DMM, or small arms berms. Previous CS sample results support this with no contaminants exceeding screening levels. For Grenade Launcher Range (FTSW-011-R-01) MRS, lead would be the most likely MC of concern in a small arms range and was not elevated significantly in 14 soil samples (including 4 from the berms) and no explosives were detected. Additional MC sampling is not proposed unless exposed fillers, burial pits containing DMM, or small arms berms are found. Surface water, sediment, and groundwater sampling is not anticipated to be required unless significant MC concentrations are found in soil.

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:	
Step 1: Review the project's objectives and sampling design (Continued)	In the event that DMM pits are found or individual munitions with exposed fillers, then two discrete soil samples will be collected, one directly beneath the item(s) and one from a depth of 1 foot below the item(s) to assess the potential point source release and determine if MC has migrated. If these results exceed background and health-based screening levels, then additional delineation and additional media sampling may need to be performed. If these results exceed background and health-based screening levels, then additional delineation and additional media sampling may need to be performed, which will consist of step out samples in the horizontal and vertical direction, as needed to bound the contamination. The spacing of step out samples will generally be 2 feet, but may be greater or lesser depending on best professional judgment in consideration of the anticipated areal extent of the release and the concentrations observed. Random sampling and incremental sampling methodology would be more appropriate for widespread contamination, which is not anticipated at this time. Where possible, disposable or dedicated equipment will be used eliminating the need for rinse blanks. Previously, the MC sampling program for the Phase 2 CS consisted of a minimum of four soils collected at each of the MRS. It should be noted that for a particular compound or analyte, the ProUCL Users Guidance for ecological risk assessment recommends at least eight sample results to be used for the 95% UCL EPC calculations. RFI field activities may identify concentrated areas of MEC/MD, firing berms, etc., in which case additional samples will be collected. As an alternative to the 95% UCL EPC calculation, the maximum detected concentration of each analyte for the four samples to be collected may be used in the risk screening and risk assessment, if needed. This approach is deemed appropriate (as compared with using a minimum of eight samples), because source areas associated with the activities at these four areas are likely to be relatively limited, such that four samples at each MRS is expected to be adequate for general site characterization purposes. Sites FTSW-009-R-01: Anti-Aircraft Range - 4A; FTSW-009-R-02: Anti-Aircraft Range - 4B; and FTSW-010-R-01: Anti-Tank Range 90-MM-2 served as firing points for anti-aircraft and anti-tank ranges. Area FTSW-011-R-01: Grenade Launcher Range Machine Gun Ranges served as an infiltration course, grenade launcher range, and small arms range firing into directed at specific targets.
Step 2A: Data Deliverables	Hard copy and electronic analytical data are delivered to the project chemist for initial review, copying, and distribution (e.g., to validator), with the original hard copy going to project central files. The CB&I Project Chemist will review these files for correctness and completeness. The laboratory will provide on CD, CLP Level 4 hardcopy and/or PDF files as well as EDDs generated by the laboratory's LIMS to include CB&I EQUIS files. The EQUIS EDDs will facilitate the data evaluation and validation process and the generation of ERIS transfer file for the upload of the data into the ERIS data depository. Data validation qualifiers will be populated for each sample/analyte into the source EDDs by the Validator (as applicable) and then verified by the Project Chemist. Data validators may also receive a working hardcopy and EDD files for their validation. The laboratory will include the EDD for each analytical batch on CD. The laboratory will address via a brief explanation in the Non-Conformance Log any non-conformance that is not within their control. The final EDD file, final laboratory non-conformance report, and results shall be provided to the project chemist and data validator to expedite the validation process and the validation qualifier fields populated. The final project deliverables may include electronic file copies of the validation reports for stakeholder use. The laboratory data will be reported for each analyte in standard DOD QSM convention for the DL, LOD, and RL. Since all final data are reported at the RL taking into account sample characteristics (e.g., volumes, dilutions, %moisture, etc.) and not the LOQ, the term RL is discussed here. In addition, any positive value detected between the DL and the RL must be reported and treated as an estimated "J" concentration. Non-detections will be reported at the LOD. Data validator may also receive a working hardcopy and EDDs for their validation. The laboratory will address via a brief explanation in the Non-Conformance Log any non-conformance that is not within their control. The final laboratory non-conformance report shall be provided with the hardcopy data package to the project chemist and data validator to expedite the validation process and the validation qualifier fields populated. The final project deliverables may include electronic file copies of the validation reports for stakeholder use.

<table>
<tr><th colspan="2">Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:</th></tr>
<tr><td>Step 2B:
Data
Verification</td><td>Data verification is defined as “confirmation by examination and provision of objective evidence that specified requirements have been fulfilled.” All data undergoes a data verification step. The data verification effort to assess laboratory performance will include a review of: completeness, COC, holding times, QC results reported on summary forms (LCS, MBs, MS/MSD, equipment blank), detection and reporting limits, and other contractual items. Criteria for QC results will be compared work plan requirements as per QAPP Worksheets #12, #15, #19, and #28 based on DoD QSM Version 5.0 and cited USEPA SW-846 or other methodology (as applicable). Analysis used for disposal criteria comparisons and not used directly in the final risk assessments; will only require a limited verification effort for completeness.

Holding Times – Consider the stability of the different analytes when holding times have not been met. Volatile organics are more susceptible to loss over time than SVOCs or metals. Except for volatile organics, samples that are reanalyzed a few days past holding time because the QC results were outside acceptance criteria, should not be rejected if they have passing criteria in the reanalysis and have comparable results to the original analyses. If the holding time for volatile organics is exceeded, the data will be rejected and there is no further use of the data.

Sample Preservation – For all analytes received in a cooler, if a sample requiring to be shipped on ice is received greater than 6 degrees Celsius (°C); professional judgment should be used as to the qualification of results. Sample preservation criteria must be adhered to whenever possible.

Blanks – Any analyte detected in the sample (other than the common volatile and semivolatile laboratory contaminants) and also detected in any associated blank, is qualified “B” if the sample concentration is less than five times (5×) the concentration in the blank, then no qualification of the sample concentration is required. Special attention will be paid when the result is near the governing criterion. Any common volatile and semivolatile laboratory contaminant detected in the sample that was also detected in any associated blank, is qualified “B” if the sample concentration is less than 10 times (10×) the blank concentration. No qualification will be assessed if the sample concentration is greater than 10× the blank concentration; and as previously stated, special attention will be paid when the result is near the governing criterion. From a data usability standpoint, samples found due to blank contamination will be considered non-detect at the RL or level of contamination (whichever is higher) because of the probability that concentrations are from laboratory or field contamination and not necessarily indicative at the site. This is consistent with USEPA Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A) and previous blank assessments conducted.

All applicable analyses should meet the recommended DoD QSM Version 5.0 as well as the method guidance found in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Update IV (USEPA, 2007), and its subsequent updates, and cited methodology guidance. The analysis includes the following:

MC Sampling (Matrix = Soil; Frequency = As needed; Period = September to December 2014) to include:

• MC and Geochemical Metals, USEPA Method SW-846 6010C Modified: Aluminum, Antimony, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, and Zinc.
• Lead, USEPA Method SW-846 6010C Modified.
• Explosives, USEPA Method SW-846 8330A Modified: HMX, RDX, 1,3,5-TNB, 1,3-DNB, Tetryl, NB, 2,4,6-TNT, 4-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2-NT, 3-NT, 4-NT, NG, and PETN.</td></tr>
</table>

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:	
Step 2B: Data Verification (Continued)	• Method modifications include: The preparation laboratory procedures for soils for metals by 6010C Mod and explosives 8330A Mod analysis will include sieving with a #10 sieve prior to digestion or extraction step. The total weight of the sample, the weight of retained material, and/or the MD should be reported, as applicable. The sample should be qualitatively described and photos may be taken, if necessary, of the contained and retained material (e.g., gravel, twigs, shot, skeet fragments). If necessary for breaking up hard clumps (e.g., dried clay), the samples should be dried and ground. In addition, the explosives 8330A Mod target list will include the additional target compounds PETN and NG. Based on the MC sampling results, additional supporting analysis may be required to verify the representativeness of the soil samples (by soil type) and provide additional supporting data for the risk assessment (Matrix = soil; Frequency = As needed; Period = September to December 2014) to include: • TOC, USEPA Method Lloyd Kahn • pH, USEPA Method SW-846 9045D
Step 2C: Full Data Validation	Data validation is defined as “confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use have been fulfilled” (USEPA QA/G-5).” A full level data validation will be performed on (see Worksheets #34 and #36): • All RFI soil samples for MC and Geochemical Metals • All RFI soil samples for Lead • All RFI soil samples for Explosives The validator will evaluate the laboratory data (by sample delivery group and method), QC results, and laboratory data qualifiers and will apply data validation qualifiers based upon set criteria set forth in this QAPP including the DoD QSM Version 5.0 and cited method criteria as applicable. These qualifiers may be different from those applied by the laboratory and determine data usability. This includes accuracy (blanks, surrogates, MSs, LCS, etc.), precision (lab duplicates, field duplicates, MSDs, LCSDs, SDs, etc.), as well as other method data quality controls such as calibrations, instrument tunes, performance and interference check samples. The Excel EDD files will aid in the validation review process. The project chemist or designee will review each data validation report and associated EDDs. The reviewer may use various checklists during the verification process to document all the verification activities. If used, completed checklists will be available for review upon request. However, these checklists will not be included as part of the data packages. All validation qualifications will be populated into the provided EDDs and explained in the data validation reports. All qualified data near the governing criteria will be evaluated against project DQOs for fitness for use (i.e., PARCCS analysis). Validation qualifiers will be consistent with *EPA National Functional Guidelines for Superfund Inorganic Data Review, EPA 540-R-10-011* (USEPA, 2010) and *EPA National Functional Guidelines for Superfund Organic Data Review, EPA 540-R-08-01* (USEPA, 2008).
Step 2D: PARCCS Analysis	The data usability assessment is performed by CB&I for data associated with delineation, risk assessment, or CS. The project chemist and/or the task lead perform the usability assessment on analytical data, as defined by PARCCS definitions. A combination of checklists and/or data validation summaries are used to document data validation activities. A QC summary report, or similar document, may be used to summarize the DQO for each task, place qualifications on data, note implications or constraints on data use, and identify an overall assessment of data completeness and usability. Part of the review to determine whether DQOs are met involves evaluating a series of data quality indicators that include measurements of the PARCCS parameters. How each of these measurements is to be performed and assessed is discussed here-in. The target acceptance criteria for the results have been developed for a wide variety of anticipated analyses on surface water and groundwater matrix samples and are presented in the internal laboratory QC validation criteria found in Worksheets #12, #15, #19, and #28. The Project Chemist completes the data review process by reviewing areas in which data non-conformances were identified by the validator. If data are determined to be un-usable (e.g., “R-flagged”), impacts (e.g., critical samples/analytes) to the project are evaluated on a case-by-case basis to determine if re-sampling or re-analysis is warranted through a corrective action report to ensure that only reliable results are used by the project and that enough usable data are available to support the decisions being made. The corrective action report addresses how this problem will be resolved and corrective actions implemented. In cases of multiple runs for each sample from sample dilutions and/or re-analysis, a “best fit” data file will be generated by the Project Chemist for final use. The best fit data will be made available for table generation for the final report and data comparisons to screening criteria in Worksheet #15. A summary of the overall project accuracy, precision, representativeness, completeness, comparability, and sensitivity is discussed in the Final RFI Report. This includes a discussion and impacts of the validation qualifications, blank assessments, sampling and analytical completeness, and analytical sensitivity analysis.

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:	
Precision	Precision refers to the reproducibility of measurements and is defined as the measurement of mutual agreement among individual measurements of the same property, usually under "prescribed similar conditions." Analytical precision is assessed through the analysis of lab duplicates, field duplicates, MSDs, and lab sample duplicates. Precision is expressed in terms of the RPD between duplicate determinations or in terms of the RSD when three or more determinations are made. Various measures of precision exist, depending on the prescribed similar conditions. Overall sampling and analysis precision are assessed using RPD for duplicate environmental samples. The RPD for MS/MSD sample results are used to assess laboratory spike recovery precision. RPD is defined as the difference between two measurements divided by their mean and expressed as a percent. RPD = 100* [(/D1-D2/) / (D1+D2/2)], where: D1 = The result from the original determination D2 = The result from a duplicate measurement.
Accuracy	Accuracy is a measure of the bias in a system or the degree of agreement of a measurement X (or an average of measurements of the same parameter) against an accepted reference or true value, T. Accuracy is typically expressed as a percent recovery calculated by the ratio of the measurement and accepted true value. Analytical accuracy is assessed through the analysis of spikes, such as surrogates, MS/MSD, and LCS; audit samples and/or standard laboratory reference materials; and calibration check verification samples. With the surrogates and MS/MSDs that are spiked onto the actual sample matrix and analyzed, these accuracy indicators must take into account the nature of the matrix in question and the native concentration of the analyte spiked. Matrix variability or interferences from high concentrations of native compounds may adversely affect spike recovery and yield less than conclusive data. Accuracy checks that focus on analytical method and consist of compounds spiked in a "blank" or non-interfering matrix (e.g., LCSs, standard laboratory reference materials, or calibration verification check samples) address the accuracy of the method and/or instrumentation in detecting the target analyte(s) at a certain quantification level and are not considered to be subject to matrix effects. % Recovery = 100*(X-S/T), where: X = The experimentally determined concentration S = The sample concentration before spiking T = The "true" concentration
Representativeness	Representativeness is a qualitative parameter that expresses the degree to which sample data actually represent the matrix conditions. Requirements and procedures for sample collection and handling are designed to maximize sample representativeness. Representativeness can also be monitored by reviewing field documentation and by performing field QA audits. Other sampling approaches where representativeness is a concern are in building composite samples and in using an unbiased grid sampling system. In compositing, individual subsamples are collected and combined to represent a greater physical area or cover a particular time period. Often, to characterize a large unknown surface area, a grid sampling pattern is established, then samples are collected at randomized node locations where horizontal and vertical traverse lines intersect. Considerations such as number of samples required and their spatial relationship will affect the degree to which the unbiased grid sample results are representative of the surface area. In such cases, the sampling objective must be well defined and the intended purpose for the sample data generated must be reviewed to establish the DQOs for representativeness through statistical analysis. Parameters, such as the number of subsamples composited, the number of samples submitted for analysis, and the sampling interval, can then be specified to increase the confidence interval and improve representativeness when warranted by the performance objective.

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:	
Completeness	Data completeness represents the percentage of usable data collected from a sampling/analytical program or measurement system compared to the amount expected to be obtained under optimal or normal conditions. Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of usable results divided by the number of possible individual analyte results and expressed as a percentage determines the completeness of the data set. For completeness requirements, usable results are all results not qualified as rejected in the data review and validation process. The requirement for completeness is 95% of all critical field samples requiring chemical analyses. For any instances of samples that could not be analyzed for any reason (holding time violations in which re-sampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported. For statistically based sampling designs, completeness will be dependent upon the number of usable samples that are needed to meet the tolerances for decision errors. The formula for calculating completeness is: %Completeness = (# of useable results / Total # of results)
Comparability	Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Comparability for sampling and analysis tasks is achieved by: • Specifying well-recognized techniques and accepted standard methods for sampling and analysis using well-trained sampling and analysis technicians to consistently execute the prescribed methods • Requiring that all involved sampling and analysis personnel produce adequate documentation to record how the prescribed methods were actually executed, noting non-conformances and corrective measures taken The specification of standardized laboratory methods helps to ensure that the data generated for an event are comparable to past and future activities. Periodic field and laboratory audits to assess consistency of method implementation for these prescribed procedures are also critical in determining comparability.
Sensitivity	Sensitivity is a qualitative parameter that addresses the ability of the analytical method or instrumentation to differentiate between responses that represent concentrations of analytes. Sensitivity is important, as it is the ability to detect the target analytes at the levels of interest so that project-specific goals are met. The requirements of sensitivity include the establishment of various limits, such as those for calibration (which include DL, LOD, and LOQ (these values are provided in the tables in Worksheet #15). The listed DLs, LODs, and LOQs are based on interference-free matrices that do not take into account the matrix effects of environmental samples. The values may change based upon the specific sample characteristics such as dilutions, sample amounts used, and percent solids (soils) for each sample and test performed. Therefore, the final project-specific values are evaluated to meet project objectives for analytes of interest during data assessments with the final reported data. The following guidelines will be considered during evaluation for usability: • Review the case narratives pertaining to the data packages and establish that corrective actions were performed • Review all validation qualifier flags based on acceptance criteria • Ascertain if the representativeness objective for the project was achieved • Consider previous investigations for the specific projects and for pre-existing data gaps • Calculate completeness of sample and analytical data collection to check against the objectives of the project • Identify data gaps based on completeness and non-conformance events • Identify data that do not meet project-specific sensitivity requirements • Evaluate if the data gaps prevent from making decisions intended in DQOs • Document instances where professional judgment should be used and discuss them with the U.S. Army Chemist • Document all evaluations, calculation, rejections, and recommendations and provide rationale for all specific validation actions

Summarize the data usability assessment process including statistics, equations, and computer algorithms that will be used to analyze the data:	
Step 3: Verify the assumptions of the selected statistical method	Verify whether underlying assumptions for selected statistical methods (if documented in the QAPP) are valid. Common assumptions include the distributional form of the data, independence of the data, dispersion characteristics, homogeneity, etc. Depending on the robustness of the statistical method, minor deviations from assumptions usually are not critical to statistical analysis and data interpretation. If serious deviations from assumptions are discovered, then another statistical method may need to be selected. Specifically: • Decision document remedy: Soil removal and groundwater monitoring (Natural Attenuation) with Land Use Controls were selected as the remedy. • Have the contaminants of concern migrated and/or degrading according to the sampled wells? • Do concentrations found pose future risks to human health and the environment? • Are proper land use controls adequate and being maintained?
Step 4: Implement the statistical method	Implement the specified statistical procedures for analyzing the data and review underlying assumptions. For decision projects that involve hypothesis testing (e.g., “concentrations of lead in groundwater are below the action level”) consider the consequences for selecting the incorrect alternative; for estimation projects (e.g., establishing a boundary for surface soil contamination), consider the tolerance for uncertainty in measurements. Specifically: • Is additional long-term monitoring required? • Are additional wells required?
Step 5: Document data usability and draw conclusions	Determine if the data can be used as intended, considering implications of deviations and corrective actions. Discuss data quality indicators. Assess the performance of the sampling design and Identify limitations on data use. Update the conceptual site model and document conclusions. Prepare the data usability summary report, which can be in the form of text and/or a table. Specifically (See PARRCS analysis): • Are any data points unusable (i.e., R-qualified) from major non-conformance(s)? • Are percent completeness indicators at or above project goals? • Has adequate sensitivity been achieved with given methodology? • Is the sampling and analytical methodologies representative for both the current round and with subsequent rounds? • Are the data comparable with subsequent rounds (i.e., trend plots)?

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Acceptance criteria — Specified limits placed on characteristics of an item, process, or service defined in requirements documents.

Accuracy — The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator. Examples of QC measures for accuracy include proficiency testing samples, matrix spikes, LCSs, and equipment blanks.

Action limit/level — The numerical value that causes a decision maker to choose or accept one of the alternative actions. It may be a regulatory threshold standard, such as a maximum contaminant level for drinking water; a risk-based concentration level; a technology limitation; or a reference-based standard.

Activity — An all-inclusive term describing a specific set of operations or related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations, equipment fabrication), that, in total, result in a product or service.

Aliquot — A measured portion of a sample taken for analysis.

Analyte — A property which is to be measured.

Analytical batch — A group of samples, including QC samples, which are processed together using the same method, the same lots of reagents, and at the same time or in continuous, sequential time periods. Samples in each batch should be of similar composition and share common internal QC standards.

Assessment — As defined in the UFP-QAPP, the evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria. Glossary of Quality Assurance and Related Terms Examples include, but are not limited to, audits, proficiency testing, management systems reviews, data quality assessments, peer reviews, inspections, or surveillance.

Audit (quality) — A systematic and independent examination to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

Bias — The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank — A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value; a sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration — A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration standard — A substance or reference material used for calibration. *See also Calibration.*

Certification — The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain-of-custody — An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Characteristic — Any property or attribute of a datum, item, process, or service that is distinct, describable, and/or measurable.

Coefficient of variation — A measure of precision (relative dispersion). It is equal to the standard deviation divided by the arithmetic mean. *See also Relative standard deviation.*

Co-located samples — See Field duplicates, co-located samples.

Comparability — The degree to which different methods or data agree or can be represented as similar. Comparability describes the confidence that two data sets can contribute to a common analysis and interpolation.

Completeness — A measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct, normal conditions.

Configuration — The functional, physical, and procedural characteristics of an item, experiment, or document.

Conformance — An affirmative indication or judgment that a product or service has met the requirements of the relevant specification, contract, or regulation; also, the state of meeting the requirements.

Contaminants of concern — The matrix-specific list of chemical compounds and analytes determined to be pertinent to a specific site or project; sometimes used interchangeably with target analytes.

Continuing calibration verification — A check of the initial calibration that is performed during the course of an analytical shift at periodic intervals using a Calibration Check Standard. Continuing calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. The purpose is to assess the continued capability of the measurement system to generate accurate and precise data over a period of time.

Contractor — Any organization or individual contracting to furnish services or items or to perform work.

Corrective action — Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Data quality indicators — The quantitative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are precision, accuracy/bias, comparability, completeness, representativeness, and sensitivity. Also referred to as data quality attributes.

Data quality objectives (DQOs) — Qualitative and quantitative statements derived from the DQO process, as defined by USEPA QA/G-4. DQOs can be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data quality objective (DQO) process — A systematic planning tool based on the scientific method that clarifies study objectives, defines the appropriate type, quantity and quality of data and specifies tolerable levels of potential decision errors needed to answer specific environmental questions and to support proper environmental decisions. The DQO process is one type of systematic planning process. *See also Systematic planning process.*

Data reduction — The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Data review — The process of examining and/or evaluating data to varying levels of detail and specificity by a variety of personnel who have different responsibilities within the data management process. It includes verification, validation, and usability assessment.

Data user — Technical and other personnel responsible for engineering, scientific, and legal evaluations that are the basis for site decisions. Data users are responsible for determining data needs required to satisfy project objectives from their perspective (remedy, risk, compliance, etc.).

Decision-maker — Project manager, stakeholder, regulator, etc., who has specific interests in the outcome of site-related activities and will use the collected data to make decisions regarding the ultimate disposition of the site or whether to proceed to the next study phase.

Definitive data — Analytical data of known quality, concentration, and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Suitable for final decision-making. *See also Screening data.*

Design — The specifications, drawings, design criteria, and performance requirement; also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.

Detection limit — A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. Detection limits are analyte- and matrix-specific and may be laboratory-dependent. *See also Method detection limit, Quantitation limit, and Sample quantitation limit.*

Distribution — (1) The appointment of an environmental contaminant at a point over time, over an area, or within a volume; (2) a probability function (density function, mass function, or distribution function) used to describe a set of observations (statistical sample) or a population from which the observations are generated.

Document — Written text such as a report, SOP, plan. Once written, documents can be revised or amended, unlike records which are not revised once written.

Document control — The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's requirements.

Environmental conditions — The description of a physical matrix (e.g., air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data — Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions. It also includes information collected directly from measurements, produced from models, and compiled from other sources such as databases or the literature.

Environmental data operations — Any work performed to obtain, use, or report information pertaining to environmental processes and conditions.

Environmental monitoring — The process of measuring or collecting environmental data.

Environmental processes — Any manufactured or natural processes that produce discharges to, or that impact, the ambient environment.

Environmental programs — An all-inclusive term pertaining to any work or activities involving the environment, including but not limited to characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Equipment blank — A sample of water free of measurable contaminants poured over or through decontaminated field sampling equipment that is considered ready to collect or process an additional sample. The purpose of this blank is to assess the adequacy of the decontamination process. Also called rinse blank or rinsate blank.

Estimate — A characteristic from the sample from which inferences on parameters can be made.

Field blank — A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport; also a clean sample exposed to sampling conditions, transported to the laboratory, and treated as an environmental sample.

Field duplicate (replicate) samples — (1) A generic term for two (or more) field samples taken at the same time in the same location. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner and provide precision information for the data collection activity. (2) The UFP-QAPP recognizes two categories of Field Duplicates Samples defined by the collection method, field duplicate, co-located samples and field duplicate, subsamples. *See also Field duplicate, co-located samples and Field duplicate, subsamples.*

Field duplicate, co-located samples — Two or more independent samples collected from side-by-side locations at the same point in time and space so as to be considered identical. These separate samples are said to represent the same population and are carried through all steps of the sampling and analytical procedures in an identical manner. These samples are used to assess precision of the total method, including sampling, analysis, and site heterogeneity. Examples of co-located samples include ambient air monitoring samples, surface water grab samples, and side-by-side sample core soil samples.

Field duplicate (replicate), subsamples — Duplicate (replicate) samples resulting from one sample collection at one sample location. For example, duplicate (replicate) subsamples may be taken from one soil boring or sediment core.

Finding — An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative and is normally accompanied by specific examples of the observed condition.

Graded approach — The objective process of establishing the project requirements and level of effort according to the intended use of the results and the degree of confidence needed in the quality of the results.

Guidance — A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or requirement.

Guideline — A suggested practice that is not mandatory in programs intended to comply with a standard.

Hazardous waste — Any waste material that satisfies the definition of hazardous waste given in 40 Code of Federal Regulations 261, “Identification and Listing of Hazardous Waste.”

Holding time — The period of time a sample may be stored prior to its required analysis.

Inspection — The examination or measurement of an item or activity to verify conformance to specific requirements.

Instrument blank — An aliquot of analyte-free water or solvent processed through the instrumental steps of the measurement process to determine the presence of carryover from the previous analysis. Analysis does not include any sample preparation.

Instrument performance check sample — A sample of known composition analyzed concurrently with environmental samples to verify the performance of one or more components of the analytical measurement process. Those components can include retention time, resolution, recovery, degradation, etc.

Interference — A positive or negative effect on a measurement caused by a analyte other than the one being investigated or other factors.

Internal standard (IS) — A standard added to a test portion of a sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias of the applied analytical method.

Investigative organization — An entity contracted by the lead organization for one or more phases of a data collection operation.

Laboratory control sample (LCS) — A sample of known composition prepared using contaminant-free water or in inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is analyzed using the same sample preparation, reagents, and analytical methods employed for regular samples.

Laboratory duplicates/replicates — Two or more representative portions taken from one homogeneous sample by the laboratory and analyzed in the same laboratory. Laboratory duplicate/ replicate samples are QC samples that are used to assess intra-laboratory preparatory and analytical precision.

Laboratory fortified blank — A low-level LCS (e.g., at the QL) used to evaluate laboratory preparatory and analytical sensitivity and bias for specific compounds.

Lead organization — An entity responsible for all phases of the data collection operation.

Limit of detection — An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory-dependent.

Limit of quantitation — The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence.

Management — Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system — A structured, nontechnical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Matrix — The material of which the sample is composed, such as water, soil/sediment, or other environmental medium.

Matrix spike (MS) — A sample prepared by adding a known concentration of a target analyte to an aliquot of a specific homogenized environmental sample for which an independent estimate of the target analyte concentration is available. The MS is accompanied by an independent analysis of the unspiked aliquot of the environmental sample. Spiked samples are used to determine the effect of the matrix on a method's recovery efficiency.

Matrix spike duplicate (MSD) — A homogeneous sample used to determine the precision of the intra-laboratory analytical process for specific analytes (organics only) in a sample matrix. The duplicate sample is prepared simultaneously as a split with the MS sample, and each is spiked with identical, known concentrations of targeted analyte(s).

Mean (arithmetic) — The sum of all the values of a set of measurements divided by the number of values in the set; a measure of central tendency.

Measurement performance criteria — Acceptance limits selected for project-specific sampling and analytical systems that will be used to judge whether project quality objectives are met. *See also data quality indicators.*

Method — A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantification), systematically presented in the order in which they are to be executed.

Method blank (MB) — A sample of a matrix similar to the batch of associated samples (when available) in which no target analytes or interferences are present at concentrations that impact the analytical results. It is processed and analyzed simultaneously with samples of similar matrix and under the same conditions as the samples.

Method detection limit (DL) — Minimum concentration of a substance that can be reported with 99 percent confidence that the analyte concentration is greater than zero. *See also Detection limit and Quantitation limit.*

Method detection limit studies — A statistical determination that defines the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero.

Must — When used in a sentence, a term denoting a requirement that has to be met.

Non-conformance — A deficiency in a characteristic, documentation, or a procedure that renders the quality of an item or activity unacceptable or indeterminate; nonfulfillment of a specified requirement.

Objective evidence — Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

Observation — An assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant effect on an item or activity. An observation may identify a condition that has not yet caused a degradation of quality.

Organization — A public or private company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, that has its own functions and administration.

Outlier — A data point that is shown to have a low probability of belonging to a specified data population.

Parameter — A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. *Parameter* is commonly misused for *variable*, *characteristic*, or *property*.

Precision — The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. Examples of QC measures for precision include field duplicates, laboratory duplicates, analytical replicates, and internal standards.

Procedure — A specified way to perform an activity.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Proficiency testing (PT) sample — A sample, the composition of which is unknown to the laboratory or analyst, which is provided to that laboratory or analyst to assess capability to produce results within acceptable criteria. PT samples can fall into three categories: (1) prequalification, conducted prior to a laboratory beginning project work, to establish initial proficiency; (2) periodic (e.g., quarterly, monthly, or episodic), to establish ongoing laboratory proficiency; and (3) batch-specific, which is conducted simultaneously with analysis of a sample batch. A PT sample is sometimes called a performance evaluation sample.

Proficiency testing (PT) sample, ampulated — A PT sample that is received as a concentrate and must be diluted to volume before being treated as an analytical sample. It can only be single blind.

Proficiency testing (PT) sample, full volume — A PT sample that is received by the laboratory ready to be treated as an analytical sample. It does not require dilution and therefore can be single or double blind.

Proficiency testing (PT) sample, site-specific — A PT sample created using a well-characterized contaminated matrix and treated as an analytical sample by the laboratory to test its capabilities.

Project — An organized set of activities within a program.

Project quality objectives (PQOs) — Qualitative and quantitative statements derived from a Systematic Planning Process (e.g., USEPA QA/G-4 DQO process) that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors. PQOs will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Project quantitation limit — The lowest concentration or amount of the target analyte required to be reported from a data collection project.

Preliminary remediation goals — Specific project action limits for target analytes.

Quality — The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria.

Quality control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Quality control (QC) sample — One of any number of samples, such as a PT sample, intended to demonstrate that a measurement system or activity is in control.

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS (continued)

Quality management — That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan — A formal document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system — A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities.

Quantitation limit (QL) — The minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified above the DL and within specified limits of precision and bias during routine analytical operating conditions.

Raw data — The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, hard copies of electronic data, magnetic tapes, untabulated sample results, QC sample results, printouts of chromatograms, instrument outputs, and handwritten notes.

Readiness review — A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

Reagent blank — An aliquot of water or solvent free of measurable contaminants analyzed with the analytical batch and containing all the reagents in the same volume as used in the processing of the samples. The MB goes through preparatory steps; the reagent blank does not.

Record (quality) — A document that furnishes objective evidence of the quality of products, services, or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery — A measure of bias. Typically, a known concentration of analyte is spiked into an aliquot of sample. Both the spiked aliquot and an unspiked aliquot of sample are analyzed and the percent recovery is calculated.

Relative percent difference (RPD) — A unit-free measure of precision between duplicate analyses.

Relative standard deviation (RSD) — A unit-free measure of precision or variability. The RSD is also known as the Coefficient of Variation, which is the standard deviation expressed as a percentage of the mean.

Remediation — The process of reducing the concentration of a contaminant (or contaminants) in air, water, or soil matrices to a level that poses an acceptable risk to human health.

Replicate samples — Multiple duplicate samples.

Representativeness — A measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition.

Reproducibility — The precision, usually expressed as variance, that measures the variability among the results of measurements of the same sample at different laboratories.

Requirement — A formal statement of a need and the expected manner in which it is to be met; documented statements that specify activities that must be done; the mandated activities.

Sample quantitation limit (SQL) — Quantitation limit adjusted for dilutions, for changes in sample volume or size, and extract and digestate volumes, percent solids, and cleanup procedures.

Scientific method — The principles and processes regarded as necessary for scientific investigation, including rules for formulation of a concept or hypothesis, conduct of experiments, and validation of hypotheses by analysis of observations.

Screening data — Analytical data of known quality, concentration, and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Screening data are of sufficient quality to support an intermediate or preliminary decision but must eventually be supported by definitive data before a project is complete.

Secondary data — Data not originally collected for the purpose for which they are now being used. In addition, the level of QA/QC provided at the time of the original data collection may be unknown.

Self-assessment — The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing or performing the work.

Sensitivity — The capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory-fortified blanks, an DL study, and initial calibration low standards at the QL.

Service — The result generated by activities at the interface between the supplier and the customer; the supplier's internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and/or field analysis, repair, and installation.

Shipping container temperature blank — A container of water designed to evaluate whether or not samples were adequately cooled during sample shipment.

Specification — A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Spike — A substance that is added to an environmental sample to increase the concentration of target analytes by known amounts. A spike is used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split sample — Two or more representative portions taken from a sample in the field or laboratory, analyzed by at least two different laboratories and/or methods. Prior to splitting, a sample is mixed (except volatiles, oil and grease, or when otherwise directed) to minimize sample heterogeneity. These are QC samples used to assess precision, variability, and data comparability between different laboratories. (Split samples should be used when accompanied by a PT sample.)

Standard deviation — A measure of the dispersion or imprecision of a sample or population distribution; expressed as the positive square root of the variance, with the same unit of measurement as the mean.

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS (continued)

Standard operating procedure (SOP) — A written document that details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.

Storage blank — A sample composed of water free of measurable contaminants and stored with a sample set in the same kind of sample container. Storage begins upon receipt of sample shipment at the laboratory. The storage blank is analyzed at the end of the sample storage period to assess cross-contamination occurring during sample storage (typically analyzed only for VOCs).

Supplier — Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement. *Supplier* is an all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surrogate spike or analyte — A pure substance with properties that mimic the analyte of interest (organics only). Surrogates are brominated, fluorinated, or isotopically labeled compounds unlikely to be found in environmental samples. These analytes are added to samples to evaluate analytical efficiency by measuring recovery.

Systematic planning process — Systematic planning is a process that is based on the scientific method and includes concepts such as objectivity of approach and acceptability of results. Systematic planning is based on a common sense, graded approach to ensure that the level of detail in planning is commensurate with the importance and intended use of the work and the available resources. This framework promotes communication among all organizations and individuals involved in an environmental program. Through a systematic planning process, a team can develop acceptance or performance criteria for the quality of the data collected and for the quality of the decision.

Target analytes — The project-specific list of analytes for which laboratory analysis is required; sometimes used interchangeably with contaminants of concern.

Technical Systems Audit — A thorough, systematic, on-site qualitative audit of facilities, equipment, personnel, training, procedures, recordkeeping, data validation, data management, and reporting aspects of a system.

Traceability — The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

Trip blank — A clean sample of water free of measurable contaminants that is taken to the sampling site and transported to the laboratory for analysis without having been exposed to sampling procedures. Trip blanks are analyzed to assess whether contamination was introduced during sample shipment (typically analyzed for VOCs only).

Usability assessment — Evaluation of data based upon the results of data validation and verification for the decisions being made. In the usability step, reviewers assess whether the process execution and resulting data meet quality objectives based on criteria established in the QAPP.

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS (continued)

Validation — Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Data validation is a sampling and analytical process evaluation that includes evaluating compliance with methods, procedures, or contracts, and comparison with criteria based upon the quality objectives developed in the project QAPP. The purpose of data validation is to assess the performance associated with the sampling and analysis to determine the quality of specified data.

Variance (statistical) — A measure or dispersion of a sample or population distribution.

Verification — Confirmation by examination and provision of objective evidence that the specified requirements (sampling and analytical) have been completed. This is to be a completeness check.

LIST OF ACRONYMS AND ABBREVIATIONS

%R........................ percent recovery
°C .... degrees Celsius
10× .... ten times
5× .... five times
AAR .... Anti-Aircraft Range
ATR .... Anti-Tank Range
bgs........................ below ground surface
CAS .... Chemical Abstract Service
CB&I .... CB&I Federal Services LLC
CCV .... Continuing Calibration Verification
CD .... Compact Disc
CLP .... Contract Laboratory Program
COC .... Chain-of-Custody
CS .... Confirmatory Sampling
CSM .... Conceptual Site Model
DDESB .... Department of Defense Explosives Safety Board
DGM .... Digital Geophysical Mapping
DL .... Detection Limit
DMM .... Discarded Military Munitions
DNB .... Dinitrobenzene
DNT .... Dinitrotoluene
DoD QSM .... DoD Quality Systems Manual for Environmental Laboratories
DoD .... U.S. Department of Defense
DOT .... U.S. Department of Transportation
DQO .... Data Quality Objective
EDD .... Electronic Data Deliverable
ELAP .... Environmental Laboratory Accreditation Program
EOD .... Explosvie Ordnance Disposal
EPC .... Exposure Point Concentration
EPD .... Environmental Protection Division
ERIS .... Environmental Restoration Information System
ESV .... Ecological Screening Value
FTSW .... Fort Stewart
GA .... Georgia
GAEPD .... Georgia Environmental Protection Division
GLR .... Grenade Launcher Range
GPS .... Global Positioning System
H&S .... Health and Safety
HMX Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC .... High Performance Liquid Chromatography
ICAL .... Initial Calibration
ICP .... Inductively Coupled Plasma Emission Spectroscopy
ICPMS .... Inductively Coupled Plasma Mass Spectrometry
ICS .... Interference Check Sample
ICV .... Initial Calibration Verification
ID .... Identification
IR .... Infrared
IS .... Internal Standard
LCS .... Laboratory Control Sample
LCSD .... Laboratory Control Sample Duplicate
LIMS .... Laboratory Information Management System
LOD .... Limit of Detection
LOQ .... Limit of Quantitation

M&TE .... Measurement and Test Equipment
MAMMS................ Multiple Award Military Munitions Services
MB .... Method Blank
MC........................ Munitions Constituents
MD........................ Munitions Debris
MDAS .... Material Documented as Safe
MDL...................... Method Detection Limit
MEC .... Munitions and Explosives of Concern
mg/kg.................... milligrams per kilogram
mm .... millimeters
MRL...................... Method Reporting Limit
MRS .... Munitions Response Site
MS .... Matrix Spike
MSA...................... Method of Standard Additions
MSD .... Matrix Spike Duplicate
NA .... Not Applicable or Not Available
NB .... Nitrobenzene
NELAC .... National Environmental Laboratory Accreditation Conference
NG .... Nitroglycerin
NT......................... Nitrotoluene
OSHA .... Occupational Safety and Health Administration
PAL....................... Project Action Limit
PARCCS .... Precision, Accuracy, Representativeness, Comparability, Completeness, and Sensitivity
PDF .... Portable Document Format
PDS .... Post-Digestion Spike
PETN.................... Pentaerythritol Tetranitrate
PM .... Project Manager
PQO .... Project Quality Objective
QA .... Quality Assurance
QA/QC.................. Quality Assurance/Quality Control
QAM .... Quality Assurance Manual
QAO .... Quality Assurance Officer
QAPP .... Quality Assurance Project Plan
QC .... Quality Control
QL......................... Quantitation Limit
RB .... Rinse Blank
RCRA .... Resource Conservation and Recovery Act
RDX...................... Hexahydro-1,3,5-trinitro-1,3,5-triazine
RFI........................ RCRA Facility Investigation
RL......................... Reporting Limit
RPD...................... Relative Percent Difference
RSD...................... Relative Standard Deviation
RSL .... Regional Screening Level
RT......................... Retention Time
SB......................... Subsurface Soil
SD .... Sample Duplicate
SOP...................... Standard Operating Procedure
SS......................... Surface Soil
SUXOS................. Senior UXO Supervisor
SVOC .... Semi-Volatile Organic Compound
TBD .... To Be Determined
TCRA.................... Time-Critical Removal Action

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

TNB .... Trinitrobenzene
TNT .... Trinitrotoluene
TOC...................... Total Organic Carbon
TP......................... Technical Paper
TPP .... Technical Project Planning
UCL .... Upper Confidence Limit
UFP-QAPP........... Uniform Federal Policy for Quality Assurance Project Plans
USACE................. U.S. Army Corps of Engineers
USAEC................. U.S. Army Environmental Command
USEPA .... U.S. Environmental Protection Agency
UXO...................... Unexploded Ordnance
UXOQCS.............. UXO Quality Control Specialist
UXOSO .... UXO Safety Officer
VOC...................... Volatile Organic Compound

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ATTACHMENT 1

CB&I STANDARD OPERATING PROCEDURES

Provided on CD

ATTACHMENT 2

SUBCONTRACTOR LABORATORY QUALITY ASSURANCE MANUAL

Provided on CD

ATTACHMENT 3

SUBCONTRACTOR LABORATORY STANDARD OPERATING PROCEDURES

Provided on CD

ATTACHMENT 4

SUBCONTRACTOR LABORATORY ELAP ACCREDITATION

Provided on CD

Appendix I

Proposed Transects and Proposed Grids

Table I-1
Fort Stewart Proposed Transects

Site	Transect Type	Transect ID	East	North
AAR4B	MAG_DIG	AAR4B-T001	442385.31180000000	3531654.52820000000
AAR4B	MAG_DIG	AAR4B-T001	442399.62340000000	3531654.52820000000
AAR4B	MAG_DIG	AAR4B-T001	442332.36110000000	3531654.52820000000
AAR4B	MAG_DIG	AAR4B-T001	442340.73890000000	3531654.52820000000
AAR4B	MAG_DIG	AAR4B-T001	442162.22140000000	3531654.52820000000
AAR4B	MAG_DIG	AAR4B-T001	442299.13750000000	3531654.52820000000
AAR4B	MAG_DIG	AAR4B-T002	442033.24620000000	3531555.52810000000
AAR4B	MAG_DIG	AAR4B-T002	442274.57580000000	3531555.52810000000
AAR4B	MAG_DIG	AAR4B-T002	442275.02470000000	3531555.52810000000
AAR4B	MAG_DIG	AAR4B-T003	441949.26490000000	3531456.52810000000
AAR4B	MAG_DIG	AAR4B-T003	442110.88040000000	3531456.52810000000
AAR4B	MAG_DIG	AAR4B-T004	441868.07230000000	3531357.52810000000
AAR4B	MAG_DIG	AAR4B-T004	442031.65300000000	3531357.52810000000
AAR4B	MAG_DIG	AAR4B-T005	441808.45720000000	3531258.52810000000
AAR4B	MAG_DIG	AAR4B-T005	442008.94570000000	3531258.52810000000
AAR4B	MAG_DIG	AAR4B-T006	441750.36530000000	3531159.52800000000
AAR4B	MAG_DIG	AAR4B-T006	441999.92760000000	3531159.52800000000
AAR4B	MAG_DIG	AAR4B-T007	441616.26710000000	3531060.52800000000
AAR4B	MAG_DIG	AAR4B-T007	441987.81170000000	3531060.52800000000
AAR4B	MAG_DIG	AAR4B-T008	441537.59790000000	3530961.52800000000
AAR4B	MAG_DIG	AAR4B-T008	441995.13710000000	3530961.52800000000
AAR4B	MAG_DIG	AAR4B-T009	441478.02120000000	3530862.52800000000
AAR4B	MAG_DIG	AAR4B-T009	442017.30990000000	3530862.52800000000
AAR4B	MAG_DIG	AAR4B-T010	441424.59460000000	3530763.52800000000
AAR4B	MAG_DIG	AAR4B-T010	442010.61230000000	3530763.52800000000
AAR4B	MAG_DIG	AAR4B-T011	441337.48430000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T011	441463.90670000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T012	441778.76610000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T012	441982.51650000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T013	441122.95110000000	3530565.52790000000
AAR4B	MAG_DIG	AAR4B-T013	441463.36480000000	3530565.52790000000
AAR4B	MAG_DIG	AAR4B-T014	441778.76600000000	3530565.52790000000
AAR4B	MAG_DIG	AAR4B-T014	441954.75790000000	3530565.52790000000
AAR4B	MAG_DIG	AAR4B-T015	440823.75680000000	3530466.52790000000
AAR4B	MAG_DIG	AAR4B-T015	441462.82280000000	3530466.52790000000
AAR4B	MAG_DIG	AAR4B-T016	440818.22370000000	3530367.52790000000
AAR4B	MAG_DIG	AAR4B-T016	441462.28090000000	3530367.52790000000
AAR4B	MAG_DIG	AAR4B-T017	440812.69060000000	3530268.52780000000
AAR4B	MAG_DIG	AAR4B-T017	441461.73890000000	3530268.52780000000
AAR4B	MAG_DIG	AAR4B-T018	442004.48770000000	3530268.52780000000
AAR4B	MAG_DIG	AAR4B-T018	442073.75900000000	3530268.52780000000
AAR4B	MAG_DIG	AAR4B-T019	440822.48990000000	3530169.52780000000
AAR4B	MAG_DIG	AAR4B-T019	441461.19700000000	3530169.52780000000
AAR4B	MAG_DIG	AAR4B-T020	441745.72560000000	3530169.52780000000
AAR4B	MAG_DIG	AAR4B-T020	442089.43650000000	3530169.52780000000
AAR4B	MAG_DIG	AAR4B-T021	441486.96360000000	3530070.52780000000
AAR4B	MAG_DIG	AAR4B-T021	442101.56360000000	3530070.52780000000
AAR4B	MAG_DIG	AAR4B-T021	440820.07290000000	3530070.52780000000

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AAR4B	MAG_DIG	AAR4B-T021	441460.65500000000	3530070.52780000000
AAR4B	MAG_DIG	AAR4B-T022	440820.42610000000	3529971.52780000000
AAR4B	MAG_DIG	AAR4B-T022	442132.98510000000	3529971.52780000000
AAR4B	MAG_DIG	AAR4B-T024	440825.81570000000	3529773.52770000000
AAR4B	MAG_DIG	AAR4B-T024	442188.45590000000	3529773.52770000000
AAR4B	MAG_DIG	AAR4B-T025	441671.02520000000	3529674.52770000000
AAR4B	MAG_DIG	AAR4B-T025	442033.15350000000	3529674.52770000000
AAR4B	MAG_DIG	AAR4B-T025	440827.39630000000	3529674.52770000000
AAR4B	MAG_DIG	AAR4B-T025	441663.58200000000	3529674.52770000000
AAR4B	MAG_DIG	AAR4B-T026	442073.18640000000	3529674.52770000000
AAR4B	MAG_DIG	AAR4B-T026	442219.41720000000	3529674.52770000000
AAR4B	MAG_DIG	AAR4B-T027	440819.59410000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T027	441482.03020000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T028	441715.90460000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T028	441840.20810000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T029	441984.74400000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T029	442068.76100000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T030	442100.62520000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T030	442207.51050000000	3529575.52770000000
AAR4B	MAG_DIG	AAR4B-T031	440800.70000000000	3529476.52770000000
AAR4B	MAG_DIG	AAR4B-T031	441527.86260000000	3529476.52770000000
AAR4B	MAG_DIG	AAR4B-T032	441571.81060000000	3529476.52770000000
AAR4B	MAG_DIG	AAR4B-T032	441656.19930000000	3529476.52770000000
AAR4B	MAG_DIG	AAR4B-T033	441677.79530000000	3529476.52770000000
AAR4B	MAG_DIG	AAR4B-T033	441717.33360000000	3529476.52770000000
AAR4B	MAG_DIG	AAR4B-T034	440823.59050000000	3529377.52760000000
AAR4B	MAG_DIG	AAR4B-T034	441573.69510000000	3529377.52760000000
AAR4B	MAG_DIG	AAR4B-T035	441027.15520000000	3529278.52760000000
AAR4B	MAG_DIG	AAR4B-T035	441598.70030000000	3529278.52760000000
AAR4B	MAG_DIG	AAR4B-T036	441173.85040000000	3529179.52760000000
AAR4B	MAG_DIG	AAR4B-T036	441631.44570000000	3529179.52760000000
AAR4B	MAG_DIG	AAR4B-T037	441358.23130000000	3529080.52760000000
AAR4B	MAG_DIG	AAR4B-T037	441642.65060000000	3529080.52760000000
AAR4B	MAG_DIG	AAR4B-T038	442195.28060000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T038	442274.57580000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T038	442296.44200000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T039	442131.12560000000	3530466.52790000000
AAR4B	MAG_DIG	AAR4B-T039	442255.55780000000	3530466.52790000000
AAR4B	MAG_DIG	AAR4B-T040	442172.97340000000	3530367.52790000000
AAR4B	MAG_DIG	AAR4B-T040	442226.67890000000	3530367.52790000000
AAR4B	MAG_DIG	AAR4B-T041	442550.59520000000	3530466.52790000000
AAR4B	MAG_DIG	AAR4B-T041	442732.74160000000	3530466.52790000000
AAR4B	MAG_DIG	AAR4B-T042	442766.76680000000	3531060.52800000000
AAR4B	MAG_DIG	AAR4B-T042	442824.33240000000	3531060.52800000000
AAR4B	MAG_DIG	AAR4B-T043	442897.06420000000	3531060.52800000000
AAR4B	MAG_DIG	AAR4B-T043	442952.56210000000	3531060.52800000000
AAR4B	MAG_DIG	AAR4B-T044	442739.97340000000	3530961.52800000000
AAR4B	MAG_DIG	AAR4B-T044	442925.15590000000	3530961.52800000000
AAR4B	MAG_DIG	AAR4B-T045	442745.25800000000	3530862.52800000000

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AAR4B	MAG_DIG	AAR4B-T045	442957.14380000000	3530862.52800000000
AAR4B	MAG_DIG	AAR4B-T046	442807.34180000000	3530763.52800000000
AAR4B	MAG_DIG	AAR4B-T046	442934.04090000000	3530763.52800000000
AAR4B	MAG_DIG	AAR4B-T047	442784.00200000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T047	442899.57040000000	3530664.52790000000
AAR4B	MAG_DIG	AAR4B-T048	443494.36220000000	3529825.73370000000
AAR4B	MAG_DIG	AAR4B-T048	443665.97360000000	3529825.46880000000
AAR4B	MAG_DIG	AAR4B-T049	443555.02800000000	3529726.17110000000
AAR4B	MAG_DIG	AAR4B-T049	443715.03090000000	3529726.29160000000
AAR4B	MAG_DIG	AAR4B-T050	443616.94330000000	3529627.45300000000
AAR4B	MAG_DIG	AAR4B-T050	443764.01640000000	3529627.25950000000
AAR4B	MAG_DIG	AAR4B-T051	443664.51550000000	3529528.48330000000
AAR4B	MAG_DIG	AAR4B-T051	443708.68560000000	3529528.35250000000
AAR4B	MAG_DIG	AAR4B-T203	440828.82510000000	3529872.52770000000
AAR4B	MAG_DIG	AAR4B-T203	442160.72050000000	3529872.52780000000
ATR90MM2	MAG_DIG	ATR90-T001	438696.04920000000	3528881.54200000000
ATR90MM2	MAG_DIG	ATR90-T001	438813.72520000000	3528881.54200000000
ATR90MM2	MAG_DIG	ATR90-T002	438607.74710000000	3528798.54200000000
ATR90MM2	MAG_DIG	ATR90-T002	438749.04460000000	3528798.54200000000
ATR90MM2	MAG_DIG	ATR90-T003	438891.39160000000	3528798.54200000000
ATR90MM2	MAG_DIG	ATR90-T003	438924.90420000000	3528798.54200000000
ATR90MM2	MAG_DIG	ATR90-T004	438909.21370000000	3528715.54200000000
ATR90MM2	MAG_DIG	ATR90-T004	439036.08320000000	3528715.54200000000
ATR90MM2	MAG_DIG	ATR90-T005	438577.71210000000	3528715.54200000000
ATR90MM2	MAG_DIG	ATR90-T005	438711.32040000000	3528715.54200000000
ATR90MM2	MAG_DIG	ATR90-T006	438547.67710000000	3528632.54200000000
ATR90MM2	MAG_DIG	ATR90-T006	438673.59630000000	3528632.54200000000
ATR90MM2	MAG_DIG	ATR90-T007	438945.45350000000	3528632.54200000000
ATR90MM2	MAG_DIG	ATR90-T007	439171.59130000000	3528632.54200000000
ATR90MM2	MAG_DIG	ATR90-T008	439327.94230000000	3528549.54190000000
ATR90MM2	MAG_DIG	ATR90-T008	439457.15680000000	3528549.54190000000
ATR90MM2	MAG_DIG	ATR90-T009	438517.64210000000	3528549.54190000000
ATR90MM2	MAG_DIG	ATR90-T009	438635.87220000000	3528549.54190000000
ATR90MM2	MAG_DIG	ATR90-T010	438487.60710000000	3528466.54190000000
ATR90MM2	MAG_DIG	ATR90-T010	438598.14830000000	3528466.54190000000
ATR90MM2	MAG_DIG	ATR90-T011	438474.41720000000	3528383.54190000000
ATR90MM2	MAG_DIG	ATR90-T011	438560.42440000000	3528383.54190000000
ATR90MM2	MAG_DIG	ATR90-T012	438464.98210000000	3528300.54190000000
ATR90MM2	MAG_DIG	ATR90-T012	438563.37600000000	3528300.54190000000
ATR90MM2	MAG_DIG	ATR90-T013	438508.15750000000	3528217.54190000000
ATR90MM2	MAG_DIG	ATR90-T013	438608.46450000000	3528217.54190000000
ATR90MM2	MAG_DIG	ATR90-T014	438413.64340000000	3528134.54180000000
ATR90MM2	MAG_DIG	ATR90-T014	438776.29220000000	3528134.54180000000
ATR90MM2	MAG_DIG	ATR90-T015	438246.21810000000	3528051.54180000000
ATR90MM2	MAG_DIG	ATR90-T015	438468.47150000000	3528051.54180000000
ATR90MM2	MAG_DIG	ATR90-T016	438521.17500000000	3528051.54180000000
ATR90MM2	MAG_DIG	ATR90-T016	438994.11190000000	3528051.54180000000
ATR90MM2	MAG_DIG	ATR90-T017	439134.95050000000	3528051.54180000000
ATR90MM2	MAG_DIG	ATR90-T017	439195.06880000000	3528051.54180000000

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ATR90MM2	MAG_DIG	ATR90-T018	439564.20770000000	3528134.54180000000
ATR90MM2	MAG_DIG	ATR90-T018	439750.10690000000	3528134.54180000000
ATR90MM2	MAG_DIG	ATR90-T019	439439.21890000000	3528051.54180000000
ATR90MM2	MAG_DIG	ATR90-T019	439821.82400000000	3528051.54180000000
ATR90MM2	MAG_DIG	ATR90-T020	440080.26150000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T020	440099.86070000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T021	439799.04440000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T021	440017.01020000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T022	439419.26980000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T022	439537.32390000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T023	439133.56610000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T023	439316.84720000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T024	438581.20720000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T024	439113.86500000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T025	438117.94930000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T025	438473.11050000000	3527968.54180000000
ATR90MM2	MAG_DIG	ATR90-T026	438125.44520000000	3527885.54180000000
ATR90MM2	MAG_DIG	ATR90-T026	439277.85180000000	3527885.54180000000
ATR90MM2	MAG_DIG	ATR90-T027	439307.14750000000	3527885.54180000000
ATR90MM2	MAG_DIG	ATR90-T027	439488.69870000000	3527885.54180000000
ATR90MM2	MAG_DIG	ATR90-T028	439812.09610000000	3527885.54180000000
ATR90MM2	MAG_DIG	ATR90-T028	440102.46240000000	3527885.54180000000
ATR90MM2	MAG_DIG	ATR90-T029	439757.82650000000	3527802.54180000000
ATR90MM2	MAG_DIG	ATR90-T029	440102.46240000000	3527802.54180000000
ATR90MM2	MAG_DIG	ATR90-T030	438169.73350000000	3527802.54180000000
ATR90MM2	MAG_DIG	ATR90-T030	439389.62960000000	3527802.54180000000
ATR90MM2	MAG_DIG	ATR90-T031	438214.02190000000	3527719.54170000000
ATR90MM2	MAG_DIG	ATR90-T031	439498.91080000000	3527719.54170000000
ATR90MM2	MAG_DIG	ATR90-T032	439595.13890000000	3527719.54180000000
ATR90MM2	MAG_DIG	ATR90-T032	439818.52480000000	3527719.54180000000
ATR90MM2	MAG_DIG	ATR90-T033	440018.74230000000	3527719.54180000000
ATR90MM2	MAG_DIG	ATR90-T033	440102.46240000000	3527719.54180000000
ATR90MM2	MAG_DIG	ATR90-T034	439997.45900000000	3527636.54170000000
ATR90MM2	MAG_DIG	ATR90-T034	440068.29140000000	3527636.54170000000
ATR90MM2	MAG_DIG	ATR90-T035	439734.33700000000	3527636.54170000000
ATR90MM2	MAG_DIG	ATR90-T035	439832.84500000000	3527636.54170000000
ATR90MM2	MAG_DIG	ATR90-T036	438258.31030000000	3527636.54170000000
ATR90MM2	MAG_DIG	ATR90-T036	439335.18510000000	3527636.54170000000
ATR90MM2	MAG_DIG	ATR90-T037	438302.59880000000	3527553.54170000000
ATR90MM2	MAG_DIG	ATR90-T037	439378.46180000000	3527553.54170000000
ATR90MM2	MAG_DIG	ATR90-T038	439845.35660000000	3527553.54170000000
ATR90MM2	MAG_DIG	ATR90-T038	439898.24660000000	3527553.54170000000
ATR90MM2	MAG_DIG	ATR90-T039	438346.88720000000	3527470.54170000000
ATR90MM2	MAG_DIG	ATR90-T039	439486.10530000000	3527470.54170000000
ATR90MM2	MAG_DIG	ATR90-T040	438391.17550000000	3527387.54170000000
ATR90MM2	MAG_DIG	ATR90-T040	439569.09280000000	3527387.54170000000
ATR90MM2	MAG_DIG	ATR90-T041	438435.46390000000	3527304.54160000000
ATR90MM2	MAG_DIG	ATR90-T041	439534.37650000000	3527304.54170000000
ATR90MM2	MAG_DIG	ATR90-T042	438436.97210000000	3527221.54160000000

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ATR90MM2	MAG_DIG	ATR90-T042	439498.48220000000	3527221.54160000000
ATR90MM2	MAG_DIG	ATR90-T043	438483.36440000000	3527138.54160000000
ATR90MM2	MAG_DIG	ATR90-T043	439462.58780000000	3527138.54160000000
ATR90MM2	MAG_DIG	ATR90-T044	438579.24790000000	3527055.54160000000
ATR90MM2	MAG_DIG	ATR90-T044	439426.69340000000	3527055.54160000000
ATR90MM2	MAG_DIG	ATR90-T045	438682.51980000000	3526972.54160000000
ATR90MM2	MAG_DIG	ATR90-T045	439390.79900000000	3526972.54160000000
ATR90MM2	MAG_DIG	ATR90-T046	438785.79180000000	3526889.54160000000
ATR90MM2	MAG_DIG	ATR90-T046	439354.90460000000	3526889.54160000000
ATR90MM2	MAG_DIG	ATR90-T047	438891.57420000000	3526806.54150000000
ATR90MM2	MAG_DIG	ATR90-T047	439319.01020000000	3526806.54150000000
ATR90MM2	MAG_DIG	ATR90-T048	438998.15850000000	3526723.54150000000
ATR90MM2	MAG_DIG	ATR90-T048	439283.11580000000	3526723.54150000000
ATR90MM2	MAG_DIG	ATR90-T049	439104.74270000000	3526640.54150000000
ATR90MM2	MAG_DIG	ATR90-T049	439247.22140000000	3526640.54150000000
ATR90MM2	DGM	ATR90-T050	439523.14760000000	3528127.58960000000
ATR90MM2	DGM	ATR90-T050	439605.30510000000	3528127.58960000000
ATR90MM2	DGM	ATR90-T051	439507.01180000000	3528112.34960000000
ATR90MM2	DGM	ATR90-T051	439630.66960000000	3528112.34960000000
ATR90MM2	DGM	ATR90-T052	439497.77480000000	3528097.10960000000
ATR90MM2	DGM	ATR90-T052	439656.03400000000	3528097.10960000000
ATR90MM2	DGM	ATR90-T053	439488.53770000000	3528081.86960000000
ATR90MM2	DGM	ATR90-T053	439681.39850000000	3528081.86960000000
ATR90MM2	DGM	ATR90-T054	439479.30070000000	3528066.62960000000
ATR90MM2	DGM	ATR90-T054	439706.76290000000	3528066.62960000000
ATR90MM2	DGM	ATR90-T055	439470.06360000000	3528051.38960000000
ATR90MM2	DGM	ATR90-T055	439732.12740000000	3528051.38960000000
ATR90MM2	DGM	ATR90-T056	439460.82660000000	3528036.14960000000
ATR90MM2	DGM	ATR90-T056	439757.49180000000	3528036.14960000000
ATR90MM2	DGM	ATR90-T057	439451.58950000000	3528020.90960000000
ATR90MM2	DGM	ATR90-T057	439782.85630000000	3528020.90960000000
ATR90MM2	DGM	ATR90-T058	439442.35250000000	3528005.66960000000
ATR90MM2	DGM	ATR90-T058	439808.22070000000	3528005.66960000000
ATR90MM2	DGM	ATR90-T059	439740.38590000000	3527990.42960000000
ATR90MM2	DGM	ATR90-T059	439833.58520000000	3527990.42960000000
ATR90MM2	DGM	ATR90-T060	439767.54080000000	3527975.18960000000
ATR90MM2	DGM	ATR90-T060	439858.94960000000	3527975.18960000000
ATR90MM2	DGM	ATR90-T061	439794.69570000000	3527959.94960000000
ATR90MM2	DGM	ATR90-T061	439884.31410000000	3527959.94960000000
ATR90MM2	DGM	ATR90-T062	439821.85060000000	3527944.70960000000
ATR90MM2	DGM	ATR90-T062	439909.67850000000	3527944.70960000000
ATR90MM2	DGM	ATR90-T063	439848.83270000000	3527929.46960000000
ATR90MM2	DGM	ATR90-T063	439935.04300000000	3527929.46960000000
ATR90MM2	DGM	ATR90-T064	439838.45270000000	3527914.22960000000
ATR90MM2	DGM	ATR90-T064	439960.40740000000	3527914.22960000000
ATR90MM2	DGM	ATR90-T065	439828.07280000000	3527898.98960000000
ATR90MM2	DGM	ATR90-T065	439985.77190000000	3527898.98960000000
ATR90MM2	DGM	ATR90-T066	439817.69290000000	3527883.74960000000
ATR90MM2	DGM	ATR90-T066	440011.13630000000	3527883.74960000000

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ATR90MM2	DGM	ATR90-T067	439807.31300000000	3527868.50960000000
ATR90MM2	DGM	ATR90-T067	440036.50080000000	3527868.50960000000
ATR90MM2	DGM	ATR90-T068	439796.93310000000	3527853.26960000000
ATR90MM2	DGM	ATR90-T068	440061.86520000000	3527853.26960000000
ATR90MM2	DGM	ATR90-T069	439786.55320000000	3527838.02960000000
ATR90MM2	DGM	ATR90-T069	440087.22970000000	3527838.02960000000
ATR90MM2	DGM	ATR90-T070	439776.17330000000	3527822.78960000000
ATR90MM2	DGM	ATR90-T070	440112.59410000000	3527822.78960000000
ATR90MM2	DGM	ATR90-T071	439765.79340000000	3527807.54960000000
ATR90MM2	DGM	ATR90-T071	440137.95860000000	3527807.54960000000
ATR90MM2	DGM	ATR90-T072	439755.41350000000	3527792.30960000000
ATR90MM2	DGM	ATR90-T072	440149.30830000000	3527792.30960000000
ATR90MM2	DGM	ATR90-T073	439966.03310000000	3527777.06960000000
ATR90MM2	DGM	ATR90-T073	440149.30830000000	3527777.06960000000
ATR90MM2	DGM	ATR90-T074	440002.52490000000	3527761.82960000000
ATR90MM2	DGM	ATR90-T074	440145.03360000000	3527761.82960000000
ATR90MM2	DGM	ATR90-T075	440022.11920000000	3527746.58960000000
ATR90MM2	DGM	ATR90-T075	440135.71290000000	3527746.58960000000
ATR90MM2	DGM	ATR90-T076	440021.40330000000	3527731.34960000000
ATR90MM2	DGM	ATR90-T076	440126.39210000000	3527731.34960000000
ATR90MM2	DGM	ATR90-T077	440017.83350000000	3527716.10960000000
ATR90MM2	DGM	ATR90-T077	440117.07140000000	3527716.10960000000
ATR90MM2	DGM	ATR90-T078	440013.79780000000	3527700.86960000000
ATR90MM2	DGM	ATR90-T078	440107.75060000000	3527700.86960000000
ATR90MM2	DGM	ATR90-T079	440011.38950000000	3527685.62960000000
ATR90MM2	DGM	ATR90-T079	440098.42990000000	3527685.62960000000
ATR90MM2	DGM	ATR90-T080	440016.33200000000	3527670.38960000000
ATR90MM2	DGM	ATR90-T080	440089.10920000000	3527670.38960000000
ATR90MM2	DGM	ATR90-T081	440044.10000000000	3527655.14960000000
ATR90MM2	DGM	ATR90-T081	440079.78840000000	3527655.14960000000
ATR90MM2	DGM	ATR90-T082	439862.23540000000	3527533.22960000000
ATR90MM2	DGM	ATR90-T082	439893.83100000000	3527533.22960000000
ATR90MM2	DGM	ATR90-T083	439842.39980000000	3527548.46960000000
ATR90MM2	DGM	ATR90-T083	439897.14400000000	3527548.46960000000
ATR90MM2	DGM	ATR90-T084	439821.95120000000	3527563.70960000000
ATR90MM2	DGM	ATR90-T084	439898.03410000000	3527563.70960000000
ATR90MM2	DGM	ATR90-T085	439801.50260000000	3527578.94960000000
ATR90MM2	DGM	ATR90-T085	439891.58640000000	3527578.94960000000
ATR90MM2	DGM	ATR90-T086	439780.87750000000	3527594.18960000000
ATR90MM2	DGM	ATR90-T086	439885.13870000000	3527594.18960000000
ATR90MM2	DGM	ATR90-T087	439758.73940000000	3527609.42960000000
ATR90MM2	DGM	ATR90-T087	439866.39060000000	3527609.42960000000
ATR90MM2	DGM	ATR90-T088	439736.47330000000	3527624.66960000000
ATR90MM2	DGM	ATR90-T088	439847.53430000000	3527624.66960000000
ATR90MM2	DGM	ATR90-T089	439712.02000000000	3527639.90960000000
ATR90MM2	DGM	ATR90-T089	439828.67800000000	3527639.90960000000
ATR90MM2	DGM	ATR90-T090	439687.56670000000	3527655.14960000000
ATR90MM2	DGM	ATR90-T090	439809.82180000000	3527655.14960000000
ATR90MM2	DGM	ATR90-T091	439663.11350000000	3527670.38960000000

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ATR90MM2	DGM	ATR90-T091	439790.96550000000	3527670.38960000000
ATR90MM2	DGM	ATR90-T092	439638.66020000000	3527685.62960000000
ATR90MM2	DGM	ATR90-T092	439796.94430000000	3527685.62960000000
ATR90MM2	DGM	ATR90-T093	439614.40900000000	3527700.86960000000
ATR90MM2	DGM	ATR90-T093	439806.64250000000	3527700.86960000000
ATR90MM2	DGM	ATR90-T094	439590.60830000000	3527716.10960000000
ATR90MM2	DGM	ATR90-T094	439816.34070000000	3527716.10960000000
ATR90MM2	DGM	ATR90-T095	439566.80750000000	3527731.34960000000
ATR90MM2	DGM	ATR90-T095	439685.11280000000	3527731.34960000000
ATR90MM2	DGM	ATR90-T096	439713.89380000000	3527731.34960000000
ATR90MM2	DGM	ATR90-T096	439826.03890000000	3527731.34960000000
ATR90MM2	DGM	ATR90-T097	439724.27370000000	3527746.58960000000
ATR90MM2	DGM	ATR90-T097	439835.73710000000	3527746.58960000000
ATR90MM2	DGM	ATR90-T098	439543.00680000000	3527746.58960000000
ATR90MM2	DGM	ATR90-T098	439661.71620000000	3527746.58960000000
ATR90MM2	DGM	ATR90-T099	439546.79140000000	3527761.82960000000
ATR90MM2	DGM	ATR90-T099	439638.31960000000	3527761.82960000000
ATR90MM2	DGM	ATR90-T100	439734.65360000000	3527761.82960000000
ATR90MM2	DGM	ATR90-T100	439845.97620000000	3527761.82960000000
ATR90MM2	DGM	ATR90-T101	439745.03350000000	3527777.06960000000
ATR90MM2	DGM	ATR90-T101	439859.52290000000	3527777.06960000000
ATR90MM2	DGM	ATR90-T102	439556.82700000000	3527777.06960000000
ATR90MM2	DGM	ATR90-T102	439614.92290000000	3527777.06960000000
ATR90MM2	DGM	ATR90-T103	439566.86260000000	3527792.30960000000
ATR90MM2	DGM	ATR90-T103	439591.52630000000	3527792.30960000000
ATR90MM2	DGM	ATR90-T104	439415.61120000000	3527838.02960000000
ATR90MM2	DGM	ATR90-T104	439457.34510000000	3527838.02960000000
ATR90MM2	DGM	ATR90-T105	439389.94210000000	3527853.26960000000
ATR90MM2	DGM	ATR90-T105	439466.92450000000	3527853.26960000000
ATR90MM2	DGM	ATR90-T106	439357.37100000000	3527868.50960000000
ATR90MM2	DGM	ATR90-T106	439477.04510000000	3527868.50960000000
ATR90MM2	DGM	ATR90-T107	439367.07390000000	3527883.74960000000
ATR90MM2	DGM	ATR90-T107	439487.47250000000	3527883.74960000000
ATR90MM2	DGM	ATR90-T108	439377.06520000000	3527898.98960000000
ATR90MM2	DGM	ATR90-T108	439497.89990000000	3527898.98960000000
ATR90MM2	DGM	ATR90-T109	439385.67770000000	3527914.22960000000
ATR90MM2	DGM	ATR90-T109	439506.77330000000	3527914.22960000000
ATR90MM2	DGM	ATR90-T110	439394.87960000000	3527929.46960000000
ATR90MM2	DGM	ATR90-T110	439515.34580000000	3527929.46960000000
ATR90MM2	DGM	ATR90-T111	439404.39290000000	3527944.70960000000
ATR90MM2	DGM	ATR90-T111	439523.91830000000	3527944.70960000000
ATR90MM2	DGM	ATR90-T112	439413.90620000000	3527959.94960000000
ATR90MM2	DGM	ATR90-T112	439532.49080000000	3527959.94960000000
ATR90MM2	DGM	ATR90-T113	439423.41950000000	3527975.18960000000
ATR90MM2	DGM	ATR90-T113	439541.06330000000	3527975.18960000000
ATR90MM2	DGM	ATR90-T114	439432.93290000000	3527990.42960000000
ATR90MM2	DGM	ATR90-T114	439549.63580000000	3527990.42960000000
GLR	MAG_DIG	GLR-T001	438957.44040000000	3525780.79660000000
GLR	MAG_DIG	GLR-T001	439030.79880000000	3525839.73940000000

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GLR	MAG_DIG	GLR-T002	438953.15140000000	3525764.52220000000
GLR	MAG_DIG	GLR-T002	439060.77800000000	3525850.99940000000
GLR	MAG_DIG	GLR-T003	438953.01700000000	3525751.58620000000
GLR	MAG_DIG	GLR-T003	439069.13260000000	3525844.88420000000
GLR	MAG_DIG	GLR-T004	438952.88260000000	3525738.65010000000
GLR	MAG_DIG	GLR-T004	439077.48730000000	3525838.76900000000
GLR	MAG_DIG	GLR-T005	438952.30000000000	3525725.35390000000
GLR	MAG_DIG	GLR-T005	439085.84200000000	3525832.65380000000
GLR	MAG_DIG	GLR-T006	438951.61990000000	3525711.97930000000
GLR	MAG_DIG	GLR-T006	439094.19660000000	3525826.53870000000
GLR	MAG_DIG	GLR-T007	438950.93980000000	3525698.60480000000
GLR	MAG_DIG	GLR-T007	439102.55130000000	3525820.42350000000
GLR	MAG_DIG	GLR-T008	438950.25970000000	3525685.23030000000
GLR	MAG_DIG	GLR-T008	439110.90600000000	3525814.30830000000
GLR	MAG_DIG	GLR-T009	438596.38490000000	3525388.06640000000
GLR	MAG_DIG	GLR-T009	439119.26060000000	3525808.19310000000
GLR	MAG_DIG	GLR-T010	439227.59870000000	3525895.24200000000
GLR	MAG_DIG	GLR-T010	439340.61680000000	3525986.05120000000
GLR	MAG_DIG	GLR-T011	438598.57650000000	3525376.99920000000
GLR	MAG_DIG	GLR-T011	439342.74800000000	3525974.93550000000
GLR	MAG_DIG	GLR-T012	438610.11550000000	3525373.44260000000
GLR	MAG_DIG	GLR-T012	439344.87920000000	3525963.81980000000
GLR	MAG_DIG	GLR-T013	438621.65440000000	3525369.88590000000
GLR	MAG_DIG	GLR-T013	439347.01040000000	3525952.70400000000
GLR	MAG_DIG	GLR-T014	438633.19340000000	3525366.32930000000
GLR	MAG_DIG	GLR-T014	439349.14160000000	3525941.58830000000
GLR	MAG_DIG	GLR-T015	438644.73230000000	3525362.77270000000
GLR	MAG_DIG	GLR-T015	439351.27270000000	3525930.47260000000
GLR	MAG_DIG	GLR-T016	438656.27130000000	3525359.21600000000
GLR	MAG_DIG	GLR-T016	439353.40390000000	3525919.35690000000
GLR	MAG_DIG	GLR-T017	438769.53600000000	3525437.39530000000
GLR	MAG_DIG	GLR-T017	439355.53510000000	3525908.24120000000
GLR	DGM	GLR-T018	438398.38020000000	3525219.70060000000
GLR	DGM	GLR-T018	438483.99560000000	3525287.73480000000
GLR	DGM	GLR-T019	438288.50980000000	3525122.65920000000
GLR	DGM	GLR-T019	438492.18730000000	3525284.51150000000
GLR	DGM	GLR-T020	438301.87450000000	3525123.54650000000
GLR	DGM	GLR-T020	438500.37910000000	3525281.28810000000
GLR	DGM	GLR-T021	438315.23930000000	3525124.43390000000
GLR	DGM	GLR-T021	438508.57080000000	3525278.06470000000
GLR	DGM	GLR-T022	438328.60410000000	3525125.32120000000
GLR	DGM	GLR-T022	438516.76260000000	3525274.84130000000
GLR	DGM	GLR-T023	438341.96880000000	3525126.20860000000
GLR	DGM	GLR-T023	438524.95430000000	3525271.61800000000
GLR	DGM	GLR-T024	438355.33360000000	3525127.09590000000
GLR	DGM	GLR-T024	438533.14610000000	3525268.39460000000
GLR	DGM	GLR-T025	438368.69830000000	3525127.98330000000
GLR	DGM	GLR-T025	438541.33780000000	3525265.17120000000
GLR	DGM	GLR-T026	438463.98250000000	3525193.96790000000

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GLR	DGM	GLR-T026	438549.52960000000	3525261.94780000000
GLR	DGM	GLR-T027	438483.83390000000	3525200.00980000000
GLR	DGM	GLR-T027	438557.72130000000	3525258.72450000000
GLR	DGM	GLR-T028	438496.26170000000	3525200.15270000000
GLR	DGM	GLR-T028	438565.91310000000	3525255.50110000000
GLR	DGM	GLR-T029	438505.57870000000	3525197.82340000000
GLR	DGM	GLR-T029	438574.10480000000	3525252.27770000000
GLR	DGM	GLR-T030	438513.69780000000	3525194.54240000000
GLR	DGM	GLR-T030	438582.29650000000	3525249.05430000000
GLR	DGM	GLR-T031	438521.04490000000	3525190.64780000000
GLR	DGM	GLR-T031	438590.48830000000	3525245.83100000000
GLR	DGM	GLR-T032	438526.46820000000	3525185.22450000000
GLR	DGM	GLR-T032	438598.68000000000	3525242.60760000000
GLR	DGM	GLR-T033	438531.66400000000	3525179.62040000000
GLR	DGM	GLR-T033	438606.87180000000	3525239.38420000000
GLR	DGM	GLR-T034	438535.14670000000	3525172.65490000000
GLR	DGM	GLR-T034	438615.06350000000	3525236.16080000000
GLR	DGM	GLR-T035	438538.49900000000	3525165.58590000000
GLR	DGM	GLR-T035	438623.25530000000	3525232.93750000000
GLR	DGM	GLR-T036	438541.03610000000	3525157.86910000000
GLR	DGM	GLR-T036	438631.44700000000	3525229.71410000000
GLR	DGM	GLR-T037	438543.57320000000	3525150.15220000000
GLR	DGM	GLR-T037	438639.63880000000	3525226.49070000000
GLR	DGM	GLR-T038	438546.11020000000	3525142.43530000000
GLR	DGM	GLR-T038	438647.83050000000	3525223.26730000000
GLR	DGM	GLR-T039	438548.64730000000	3525134.71840000000
GLR	DGM	GLR-T039	438656.02230000000	3525220.04400000000
GLR	DGM	GLR-T040	438551.18430000000	3525127.00160000000
GLR	DGM	GLR-T040	438664.21400000000	3525216.82060000000
GLR	DGM	GLR-T041	438553.96570000000	3525119.47880000000
GLR	DGM	GLR-T041	438672.40580000000	3525213.59720000000
GLR	DGM	GLR-T042	438559.32830000000	3525114.00730000000
GLR	DGM	GLR-T042	438680.59750000000	3525210.37380000000
GLR	DGM	GLR-T043	438595.90920000000	3525133.34340000000
GLR	DGM	GLR-T043	438688.78930000000	3525207.15050000000
GLR	DGM	GLR-T044	438639.16110000000	3525157.98050000000
GLR	DGM	GLR-T044	438696.98100000000	3525203.92710000000
GLR	DGM	GLR-T045	438682.41300000000	3525182.61770000000
GLR	DGM	GLR-T045	438705.17280000000	3525200.70370000000

Table I-2
Fort Stewart Proposed Grids

Site	Grid Type	Grid ID	East	North	Description
AAR4B	DGM	AAR4B-G001	441851.07970000000	3529307.98270000000	Southwest Corner
AAR4B	DGM	AAR4B-G002	442220.65590000000	3529501.72260000000	Southwest Corner
AAR4B	DGM	AAR4B-G003	442544.36210000000	3529641.10730000000	Southwest Corner
AAR4B	DGM	AAR4B-G004	442743.59570000000	3529733.09100000000	Southwest Corner
AAR4B	DGM	AAR4B-G005	443128.85700000000	3529922.05820000000	Southwest Corner