Final

WORK PLAN

PARCEL 11

SOLID WASTE MANAGEMENT UNITS 10 AND 40

Fort Wingate Depot Activity
McKinley County, New Mexico

April 22, 2015

Contract No. W912DY-10-D-0025

Task Order No. DS02

Prepared for:

United States Army Corps of Engineers

CESWF-PEC-TM

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Room 3A12

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14. ABSTRACT
This MEC Removal and Investigation Work Plan summarizes previous investigations and describes field activities that will be conducted at Parcel 11 SWMUs 10 and 40 at Fort Wingate Depot Activity, New Mexico. T his document has been prepared form submission to the New Mexico Environmental Department (NMED) Hazardous Waste Bureau (HWB) as required by Section VI.H.1 of the Resource Conservation and Recovery Act (RCRA) Permit No. NM 6213820974.

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McKinley County, New Mexico

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Totals	**11**	**33**

BRACD = U.S. Army Base Realignment and Closure Division

FWDA ARM = Fort Wingate Depot Activity Administrative Records Manager

FWDA BEC = Fort Wingate Depot Activity Base Realignment and Closure Environmental Coordinator

FWDA EIMS = Fort Wingate Depot Activity Environmental Information Management System

USACE SWF = U.S. Army Corps of Engineers, Fort Worth District

USACE SPA = U.S. Army Corps of Engineers, Albuquerque District

USACE SPK = U.S. Army Corps of Engineers, Sacramento District

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ACRONYMS

AOC	Area of Concern
APP	Accident Prevention Plan
BIA	Bureau of Indian Affairs
BIP	Blow in Place
BRAC	Base Realignment and Closure Committee
CAMU	Corrective Action Management Unit
CE	Conditional Exemption
CEHSM	Corporate Environmental Health and Safety Manager
CFR	Code of Federal Regulations
DDESB	Department of Defense Explosives Safety Board
DID	Data Item Description
EM	Engineering Manual
EPP	Environmental Protection Plan
ESS	Explosive Safety Submission
EZ	Exclusion Zone
ft	Feet
FWDA	Fort Wingate Depot Activity
GPS	Global Positioning System
HAZWOPER	Hazardous Waste Operations and Emergency Response
HWCP	Hazardous Waste Contingence Plan
IAW	In Accordance With
ISO	Industry Standard Object
lbs	Pounds
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented As Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
MFD	Maximum Fragmentation Distance
MGFD	Munition with Greatest Fragmentation Distance
mm	Millimeter
mV	Millivolt

MPPEH	Material Potentially Presenting an Explosive Hazard
MRSPP	Munition Response Site Prioritization Protocol
MSD	Minimum Separation Distance
NEW	Net Explosive Weight
NFPA	National Fire Protection Agency
NM	New Mexico
NMED	New Mexico Environment Department
OE	Ordnance and Explosives
OESS	Ordnance and Explosives Safety Specialist
OSHA	Occupational Safety and Health Administration
POC	Point of Contact
PPE	Personal Protective Equipment
QC	Quality Control
RCRA	Resource Conservation Recovery Act
SSHP	Site Safety and Health Plan
SWMU	Solid Waste Management Unit
SUXOS	Senior UXO Supervisor
TEAD	Tooele Army Depot
TM	Technical Manual
TP	Technical Paper
USACE	United States Army Corps of Engineers
UXO	Unexploded Ordnance
UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
WP	Work Plan
WMP	Waste Management Plan

1.0 INTRODUCTION

This Resource Conservation and Recovery Act (RCRA) Munitions and Explosives of Concern (MEC) Investigation and Removal Work Plan summarizes previous investigations and describes additional MEC investigation and removal activities to be completed at Solid Waste Management Units (SWMUs) 10 and 40 in Parcel 11 at Fort Wingate Depot Activity (FWDA), New Mexico (NM). The location of FWDA is shown in Figure 1-1; the parcels within FWDA are shown in Figure 1-2. The efforts addressed in this work plan are associated with two SWMUs of the Parcel 11's 10 SWMUs and 6 Areas of Concern (AOCs). SWMUs 10 and 40 are shown on Figure 1-3. A companion to this document, the Final RCRA Facility investigation (RFI) Report Parcel 11, Revision 2.0 (USACE, 2014), has been prepared to describe results of investigations conducted as part of the environmental restoration program at FWDA. An additional companion document, the Historical Information Summary Document for Parcel 11, has been prepared to compile and summarize historical documents available for Parcel 11 SWMUs and AOCs. The Historical Information Summary Document details the operational history, site and facility drawings and environmental information contained in previous completed reports for Parcel 11 SWMUs and AOCs.

As required by RCRA Permit Section VIII.B., this work plan will be distributed to designated representatives of the Navajo Nation and Pueblo of Zuni for their review and comment. Comments received from the tribal stakeholders will be incorporated into the final work plan.

1.1 PURPOSE AND SCOPE

The purpose of this MEC Investigation and Removal Work Plan is to conduct removal and additional investigation for MEC in selected areas of Parcel 11 as recommended by the Army in the RCRA Facility Investigation Report, Parcel 11, Fort Wingate Depot Activity (hereafter referred to as the RFI Report, USACE, 2014).

1.2 BACKGROUND INFORMATION

Complete background information regarding FWDA and Parcel 11 is provided in numerous documents previously submitted to the New Mexico Environment Department (NMED), including the following:

- *Final - RCRA Facility Investigation Report, Parcel 11*, Revision 2, volume 1, 2, 3 - FWDA (USACE Fort Worth, 2014);
- Summary Report of Historical Information, Parcel 11 – FWDA (Terranear PMC (TPMC), 2009)

- *RCRA Facility Investigation Work Plan Final, Parcel 11*, Revision (TPMC, 2009) (hereafter referred to as the RFI Work Plan, TPMC, 2009)

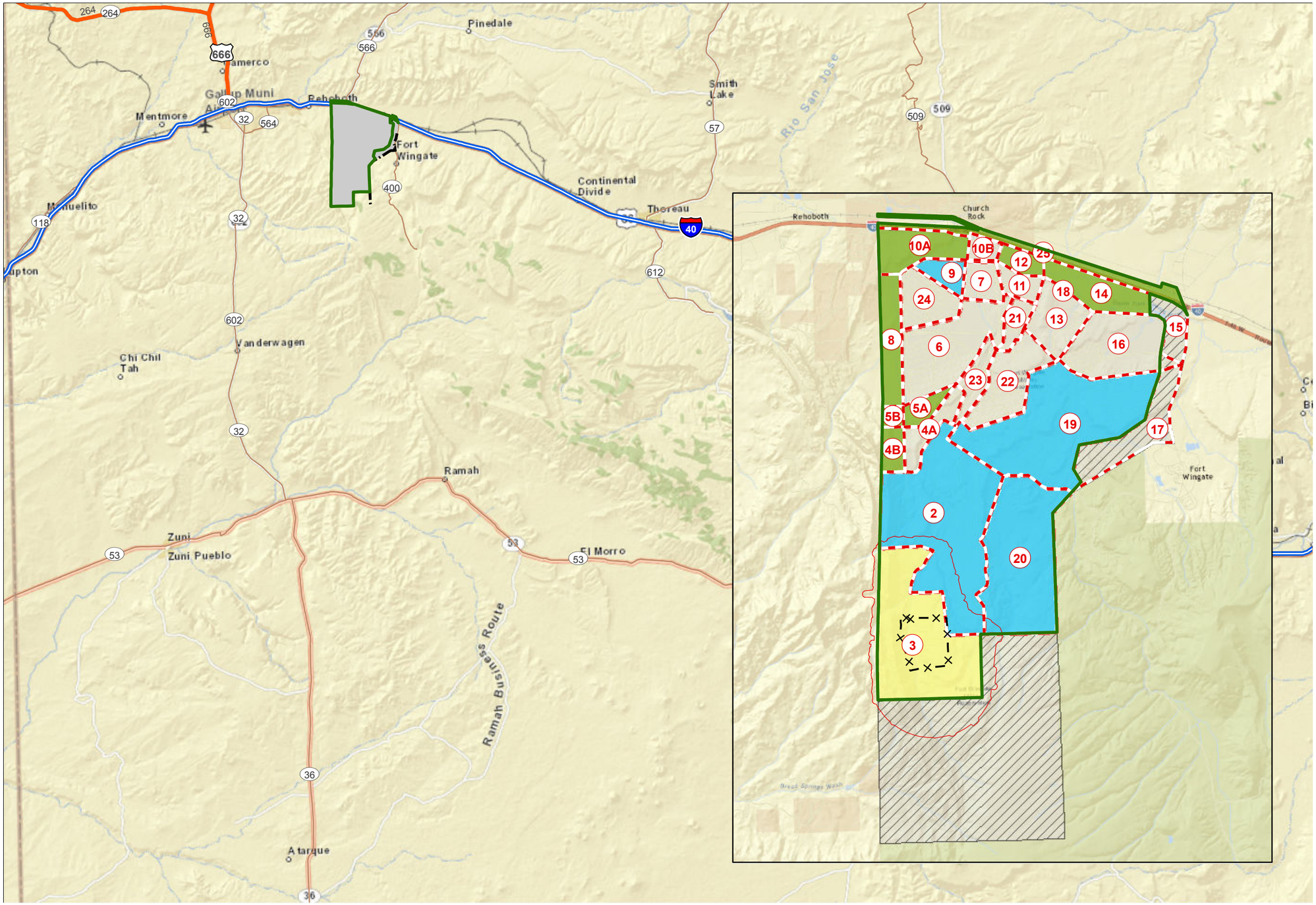
Parcel 11 is approximately 172 acres in size and includes SWMU 10, the Sewage Treatment Plan (STP), and SWMU 40, the South Administration Area. Utilities are present in several areas throughout Parcel 11. Characterization activities were conducted in accordance with (IAW) the NMED approved RFI Work Plan (TPCM, 2009). RFI activities were detailed in the RFI Report (USACE 2014). The activities described in this Plan have been developed to address recommendations of the NMED Hazardous Waste Bureau (HWB) and to implement supplemental recommendations made by the Army in the RFI Report.

Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 1-1

Regional Area Map



Legend

- FWDA Boundary 1993
- FWDA Installation Boundary
- Army Parcel Boundary
- Kickout Area (KOA)
- Inner Fence
- 20 Parcel Number

Parcel Status

- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit

N

0 3 6 12 Miles

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Datum: WGS 84	CS: UTM 12N	

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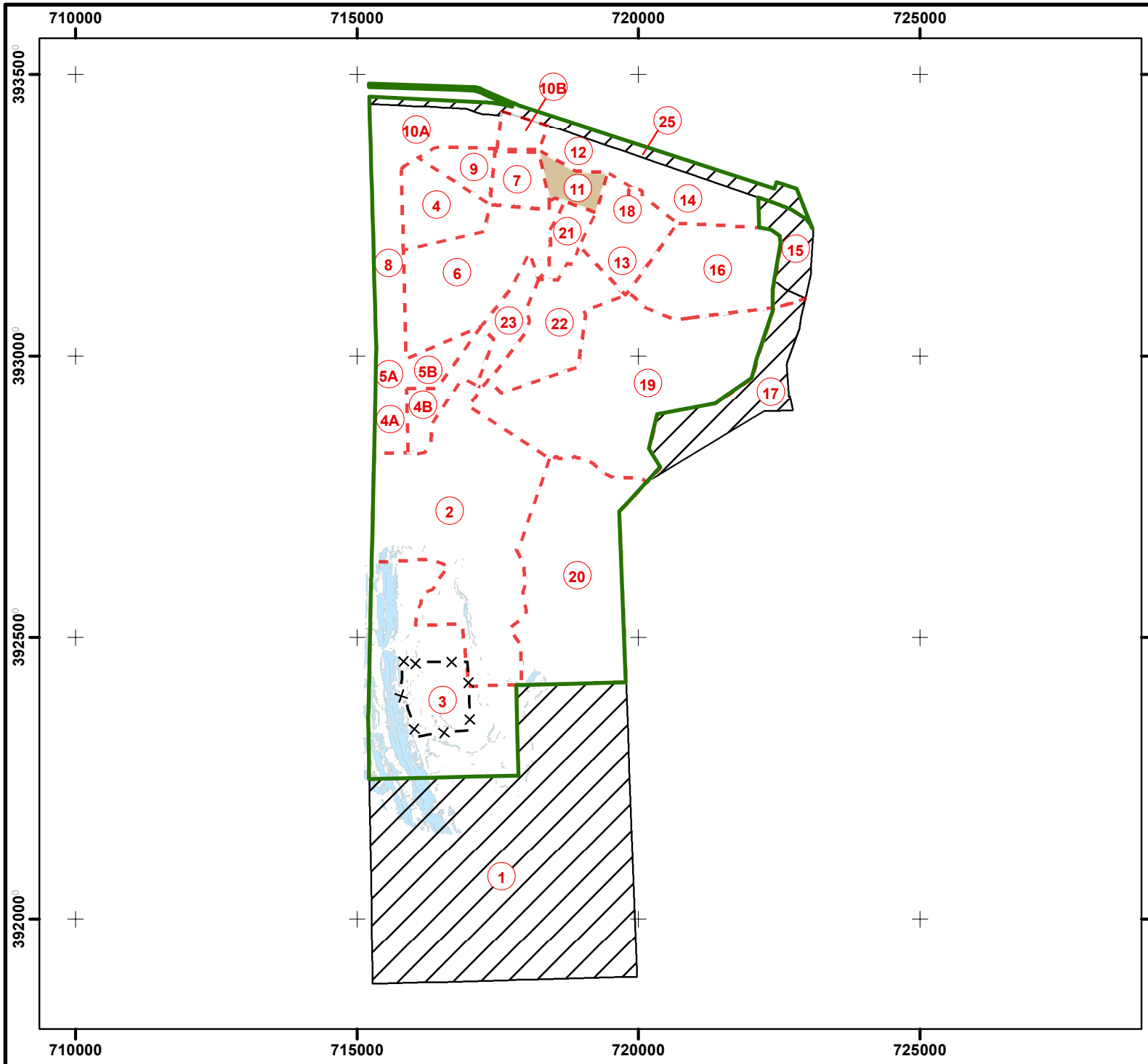
PIKA ARCADIS MALCOLM PIRNIE A JOINT VENTURE

Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 1-2

Parcel 11 SWMU 10 and 40 Work Plan - Historical Land Use and Reuse Parcel Boundaries

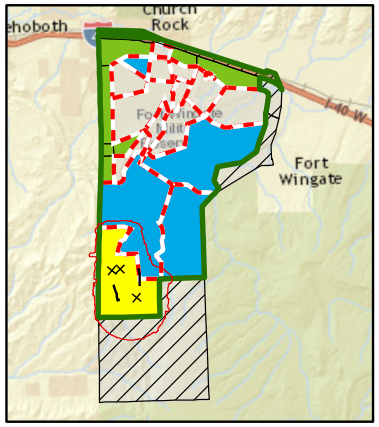


Legend

- Installation Boundary
- Parcel 11
- Inner Fence
- Inaccessible Area

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- (11) Parcel Number



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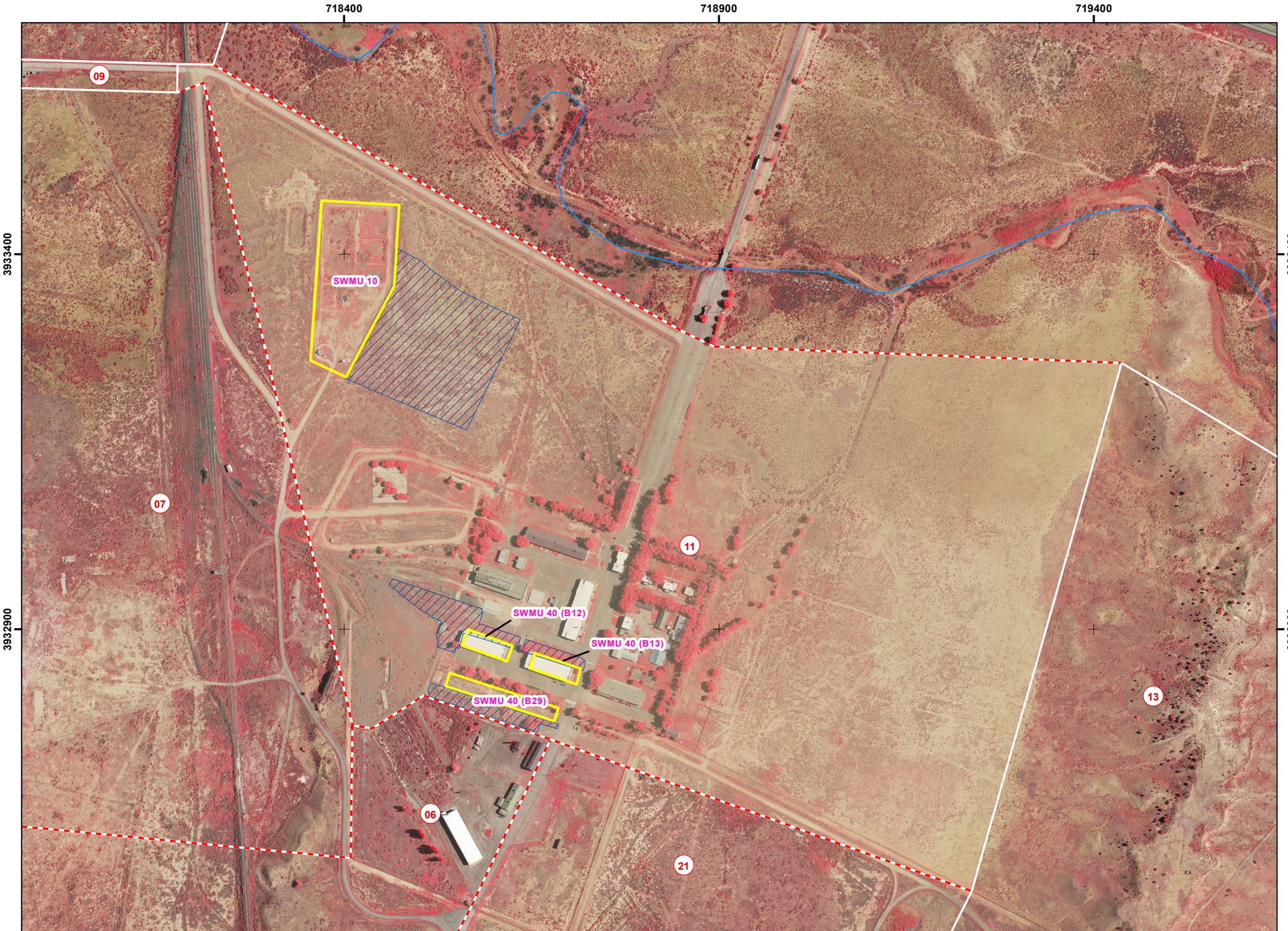


Fort Wingate Depot Activity
McKinley County, New Mexico

Figure 1-3

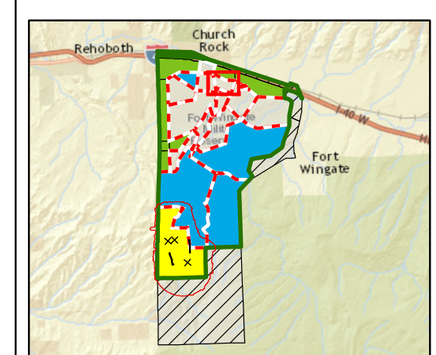
Parcel 11 SWMUs 10 and 40

Legend

- Installation Boundary
- SWMU/AOC
- Parcel 11
- Approximate Extent of Geophysical Investigation
- Arroyo/Stream

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- 11 Parcel Number



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Datum: **WGS 84**	CS: **UTM 12N**		PDF: \\arcadis-us.com\officedata\HoffmanEstates-IL\Project\ARMY\Fort_Wingate\PDFs\WP\Parcel_11

PIKA
ARCADIS MALCOLM PIRNIE
A JOINT VENTURE

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2.0 CULTURAL RESOURCES

Traditional cultural properties (TCPs) and other cultural resources have been documented within the FWDA boundaries. Based on a review of available mapping (UNM OCA, 1994), it appears there no identified sites within Parcel 11. While no previously identified sites are present within Parcel 11, the Army will follow procedures documented in the Programmatic Agreement (PA) with the Navajo Nation and Pueblo of Zuni which specifies procedures to be employed during environmental characterization and remediation activities.

Maps showing the locations of TCPs and other cultural resources relative to the MEC removal and investigations areas will not be included in this Work Plan, which is a public document. Instead, the consultation process will include review of this work plan by tribal cultural resource personnel to confirm the presence or absence of identified cultural resources within the removal and investigation areas. If needed, tribal cultural resource personnel will evaluate the SWMU 10 MEC removal and SWMU 40 investigation areas prior to the initiation of intrusive activities. If appropriate, tribal cultural resource and archaeological personnel will be on-site during intrusive activities as described in the PA.

3.0 BACKGROUND

3.1 SITE DESCRIPTION AND OPERATIONAL HISTORY

The FWDA installation is located approximately eight miles east of Gallup, New Mexico, and currently occupies approximately 24 square miles (approximately 15,277 acres) of land in in McKinley County in northwestern NM. FWDA contained facilities used to operate a reserve storage activity providing for the care, preservation, and minor maintenance of assigned commodities, primarily conventional military munitions. FWDA is almost entirely surrounded by federally owned or administered lands, including both National forest and Tribal lands. The installation can be divided into several sub-areas based on location and historical land use. The major land use areas include the following:

- The Administration Area – encompassing approximately 800 acres in the northern portion of the installation, which contains former office facilities, housing, equipment maintenance facilities, warehouse buildings, and utility support facilities.
- The Workshop Area – encompassing approximately 700 acres to the south of the Administration Area, which consists of an industrial area containing former ammunition, maintenance and renovation facilities, the former trinitrotoluene (TNT) washout facility, and the TNT leach beds area.
- Ten Munitions Storage Areas (Igloo Blocks A through H, J, and K) – encompassing approximately 7,400 acres in the central portion of the installation. This area has 732 earth-covered igloos and 241 earthen revetments previously used for the storage of munitions.
- The Open Burning/Open Detonation (OB/OD) Area – encompassing approximately 1,800 acres in the west-central portion of the installation, which is separated into two sub-areas based on the period of operation, the Closed OB/OD Area and the Current OB/OD Area.
- Protection and Buffer Areas – encompassing approximately 4,050 acres located adjacent to the eastern, western, and northern installation boundaries, which consists of buffer zones surrounding the former magazine and demolition areas.

The FWDA installation was originally established by the U.S. Army in 1862 at the southern edge of the Navajo territory. In 1918, the mission of the FWDA changed from management of tribal issues to World War I (WWI) related activities. Beginning in 1940, the FWDA's mission was primarily to receive, store, maintain, and ship explosives and military munitions, as well as to disassemble and dispose of

unserviceable or obsolete explosives and military munitions. In 1975, the installation came under the administrative command of Tooele Army Depot (TEAD), located near Salt Lake City, Utah.

In January 1993, the active mission of the FWDA was ceased and the installation closed as a result of the Defense Base Realignment and Closure Act (BRAC) of 1990. Beginning in 2002, the U.S. Army reassigned many FWDA functions to the BRAC Division, including caretaker duties, property transfer, and performance of environmental compliance and restoration activities. Command and control responsibilities were retained by TEAD until January 31, 2008, when these responsibilities were transferred to White Sands Missile Range (WSMR).

FWDA installation is currently undergoing final environmental characterization and restoration activities prior to final property transfer and reuse. The installation has been divided into reuse parcels as part of the planned property transfer to the U.S. Department of the Interior (DOI). This MEC Investigation and Removal Work Plan only relates to the Parcel 11 SWMUs indicated below:

- SWMU 10 20mm Anomaly Area
- SWMU 40 Buildings 12, 13 and Former Building 29 Area

3.2 SITE CONDITIONS

The following subsections, excerpted from the Parcel 11 RFI Report (USACE, 2014), provide an overall summary of site conditions at FWDA. The full descriptions of the site conditions are available in the Parcel 11 RFI Report.

3.2.1 Climate

Northwestern NM is characterized by a semiarid continental climate. Most precipitation occurs from May through October. Most of the precipitation occurs as rain or hail in summer thunderstorms, and the remainder results from light winter snow accumulations (Metcalf & Eddy, Inc. [M&E], 1992). Spring and fall droughts characterize the area. Mean annual rainfall for the area ranges between 10 and 16 inches, while the recorded average annual precipitation for the FWDA is 11 inches. Depending on local elevations, mean annual rainfall fluctuates between eight and 20 inches.

The average seasonal temperatures for the area vary with elevation and topographic features. During winter, daily temperatures fluctuate as much as 50 to 70 degrees Fahrenheit (°F) in a 24-hour period. In summer, daily high temperatures are between 85°F and 95°F (M&E, 1992). Average temperatures in winter are about 27°F and in summer 70°F, while extreme temperatures are as low as -30°F in winter and

as high as 100°F in summer. There are 100 to 150 frost-free days during the year from the middle of May to the middle of October (M&E, 1992).

3.2.2 Topography

The elevation of the FWDA ranges from approximately 8,200 feet (ft) above mean sea level (MSL) in the south to 6,660 ft above MSL in the north. Topographically, the FWDA may be divided into three general areas: 1) the rugged north to south trending the Hogback along the western and the southwestern boundaries; 2) the northern hilly slopes of the Zuni Mountains in the southern portion; and 3) the alluvial plains marked by bedrock remnants in the northern portion of the installation.

Main drainages, following the topography, generally flow from south to north and discharge to the South Fork of the Puerco River near the northern boundary of the FWDA. However, many tributaries follow the regional trend, flowing from southwest to northeast. During rainfall and snowmelt events, streams transport sediment to low-lying areas in the northern part of the installation, creating an extensive alluvial fan deposit among remnants of bedrock.

Parcel 11 is relatively flat with surface runoff during rainfall/snowmelt events generally entering the Administration Area storm water system and discharges via ditches to the Rio Puerco River located to the north of Parcel 11, or pools and infiltrates or evaporates in other areas. No surface water bodies or intermittent stream channels exist within Parcel 11.

3.2.3 Vegetation/Habitat

The regional climate supports Ponderosa Pine and mixed fir forests above 7,500 ft and predominantly piñon and juniper forests from 6,800 to 7,500 ft; shrubs and grasses dominate below 6,800 ft (Roberston et al., 2013). The vegetation for Parcel 11 includes moderate grasslands and sagebrush.

3.2.4 Soils

The soils found on the installation are similar to those occurring in cool plateau and mountain regions of NM. The major soil types at the FWDA are variants/complexes of sands, loams, clays, gravel, and exposed bedrock units. These soils are relatively thin, and the parent bedrock is either at or near the surface in more than a quarter of the installation.

The primary soil type in the southern portion of Parcel 11 is the Aquima-Hawaikuh silt loams and the primary soil type in the northern portion of Parcel 11 is the Rehobeth silty clay loam. A small area of Zia sandy loam is present in the western portion of the parcel, and a small area of Bamac extremely gravelly sandy loam is present on the eastern portion of the parcel (USACE, 2014).

3.2.5 Geology

In 1997, geologic mapping of portions of the FWDA and a fracture trace analysis were conducted by the U.S. Geological Survey (USGS). Geologic units exposed at the ground surface throughout much of the FWDA were identified. Results of this study, combined with information from geologic literature, are summarized below to provide a description of the geologic and stratigraphic setting of the portion of the FWDA in which Parcel 11 is located.

The FWDA is underlain primarily by Triassic mudstone and sandstone layers that are tilted gently to the northwest. In the western and southern portions of the installation; however, Jurassic and Cretaceous sandstone and claystone layers are exposed along the Nutria Monocline (the Hogback), which is a steeply west -dipping, north -trending monoclinal fold (USACE, 2014).

Recent alluvial sediments cover much of the land area in the Administration and TNT Leaching Beds Area. These sediments consist predominately of silts and clays, with discontinuous bodies of sand and occasionally gravel. To the north of the developed portion of the Administration Area, the near surface sediments are dominated by the substantially more sandy riverine deposits associated with the Rio Puerco. According to U.S. Soil Conservation Service studies in 1981, four soil units occur on FWDA land: (1) Camborthids-Torriothents soils, which are shallow to deep loams and clays that occur on plains hillslopes (slopes of one to 12 percent) and occupy nearly the entire northeastern quarter of the installation; (2) Torriothents-Rock Outcrop soils, which are shallow, loamy soils and rock outcrop on the dissected plateaus, escarpments, and hillslopes (slopes three to 60 percent) on the north central-western quarter of FWDA; (3) Rock Outcrop-Haplustolls Argiustolls soils, which are shallow, loamy, and clayey soils, rolling over steep hillsides and canyon walls (slopes of 30 to 70 percent), and are situated in the central (east-to-west) zone, and constitute less than half of the southern portion of the property; and (4) Eutrobocalfs-Argiborolls soils, which are shallow to moderately deep loams and clays, and occur on slightly sloping to steep areas in the mountainous southeastern part of the installation (USACE, 2014).

Generally, the soils are loamy or loam/clay mixtures, and contain varying amounts of silt, sand, gravel, and rock fragments. Wind and water cause extensive soil erosion, especially where vegetative cover is absent. The alluvial/riverine deposits of the area of investigation are underlain by the Triassic Petrified Forest Formation, which comprises greater than 75 percent of the bedrock exposed at the surface throughout FWDA. The Petrified Forest Formation consists primarily of mudstone, claystone, and minor amounts of muddy sandstone. A middle member consisting of a relatively thick, continuous sandstone layer (Sonsela Sandstone Member) separates the upper and lower members. The Painted Desert Member is the upper member of the Petrified Forest Formation. This member consists of mudstone, siltstone, sandy-mudstone, and lenticular sandstone layers. Sandstone lenses within the Painted Desert Member are thin (generally less than 20 ft thick), laterally discontinuous, and contain high quantities of very fine, muddy matrix. As a result, the apparent permeability of these lenses, and the Painted Desert Member as a whole, is very low. The Painted Desert Member is exposed at the ground surface on the areas of higher ground surface elevations located east, south, and southwest of the Administration and TNT Leaching Beds Areas.

The Sonsela Sandstone Member (middle member of the Petrified Forest Formation) is of variable thickness (20 to 80 ft thick) and is laterally continuous. This unit is a clean, well-sorted, quartzose sandstone that contains very small amounts of matrix and therefore has a high apparent permeability. Below the Sonsela Sandstone Member is the lower member of the Petrified Forest Formation, the Blue Mesa Member. The lithology and apparent permeability of the Blue Mesa Member is similar to that of the Painted Desert Member.

The Moenkopi Formation, the San Andres Limestone, and the Glorieta Sandstone underlie the Blue Mesa Member. The lower Petrified Forest Formation and the Moenkopi Formation comprise 250 to 300 ft of mudstones and sandstones. These units are underlain by approximately 100 ft of the Permian San Andres Limestone which is underlain by approximately 120 ft of the Glorieta Sandstone.

Younger Jurassic and Cretaceous sandstone and claystone layers have been eroded in the TNT Leaching Beds Area. These units are exposed from the Hogback to the western FWDA boundary. The Jurassic Entrada Sandstone, Zuni Sandstone, and Morrison Formation account for approximately 1,200 ft of massive, cross-bedded sandstones with a high apparent permeability. Above these units is a series of Cretaceous claystones and sandstones including the Dakota Sandstone (approximately 200 ft thick), the Mancos Claystone (approximately 600 ft thick), and the Gallup Sandstone (approximately 200 ft thick).

Structural Geology Bedrock underlying the majority of the FWDA installation dips gently to the northwest at an angle of approximately five degrees. The structural orientation of the bedrock substantially influences the movement of ground water. The ground water flow gradient across the installation is primary to the north-northwest, generally following the structural dip of the geologic units.

4.0 REMOVAL AND INVESTIGATION METHODS

A surface and subsurface removal of MEC and metallic debris the size of 20mm and larger will be performed at the SWMU 10 20mm Anomaly Area and a statistical sampling of subsurface anomalies at the SWMU 40 Building 12, 13 and former Building 29 areas where a previous geophysical investigation was performed. The procedures stated below will be performed during the execution of the work in the two SWMUs.

4.1 PREVIOUS INVESTIGATIONS

The environmental restoration process has been underway for more than 30 years at the FWDA. In 1980, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) guidelines began to guide the environmental restoration activities at FWDA other than those in the OB/OD Area, with the U.S. Environmental Protection Agency (EPA) Region 6 as the lead regulatory agency. In 1996, the NMED was granted regulatory authority under RCRA and they became the lead regulatory agency at the site. Activities are currently performed under the RCRA Permit issued in 2005, revised in April 2014.

Available historical information from prior investigations for FWDA sites that lie within what is now identified as Parcel 11 have been compiled and summarized in the Summary Report of Historical Information, Parcel 11 – FWDA (TPMC, 2009). The Summary Report provides a listing of site surveys, data compilation efforts, operational history, site or facility drawings, and environmental investigations that have been contained in previously completed reports and which are pertinent to sites now considered to be within Parcel 11. Included in the Summary Report is a brief summary of findings and conclusions from the relevant historical site investigation efforts.

The Final Parcel 11 RFI Report (USACE, 2014) reported the investigation results of Parcel 11 SWMUs and AOCs. Based on the results of MEC related investigations at SWMUs 10 and 40, the Army recommends conducting additional actions in these SWMUs. Specifically, the analysis of the geophysical data collected during the RFI identified subsurface anomalies with the potential to be MEC-related at the SWMU 10 20mm Anomaly Area and the SWMU 40 Buildings 12, 13 and former Building 29 area. Additional detail of the MEC-related prior environmental investigations at SWMUs 10 and 40 are provided in Sections 5.2 and 6.2 below.

4.2 EVALUATION OF EXISTING MEC RELATED DATA

4.2.1 SWMU 10

During RFI field work, surface and geophysical inspections were performed in approximately 7 acres east of the STP and incinerator. Munitions debris (MD), related to 20 millimeter (mm) projectiles, and metal scrap was identified on the ground surface by UXO-qualified personnel. The USGS performed a digital geophysical mapping (DGM) survey over the entire area in October 2009. An analysis of the geophysical data indicates anomalies are present that have the potential to be MEC and/or munitions debris. A removal action at SWMU 10 will be conducted, using the USGS DGM data to identify subsurface targets to intrusively investigate to remediate potential MEC hazards.

4.2.2 SWMU 40

In October 2009, the USGS performed a DGM survey near Buildings 12, 13, and former Building 29 in SWMU 40. Numerous subsurface anomalies were identified in the USGS data, but the anomalies were not intrusively investigated. An analysis of the geophysical data around Buildings 12, 13 and former Building 29 indicated anomalies are present that have the potential to be MEC. The Army will conduct an investigation at SWMU 40, using the USGS DGM data to identify targets to intrusively investigate and characterize geophysical anomalies.

4.3 DATA QUALITY OBJECTIVES

The process used for development of the data quality objectives (DQOs) for additional characterization and/or remediation activities at Parcel 11 is described below:

SWMU 10 DQOs

Statement of Problem

MEC, in the form of 20mm projectiles, is potentially present at the site. To address the potential MEC hazard, identify and remove anomalies that are characteristic of 20 mm projectiles or larger, based on existing DGM data in the seven acre area adjacent to the STP.

Identification of a Decision which Addresses the Problem (Project Goals)

Determine the subsurface anomalies that meet an appropriate anomaly selection criteria that corresponds to potential 20 mm projectiles or larger, and remove these anomalies in the subject area. If 20 mm projectiles or larger munitions are found during the intrusive investigation, a second phase of removal

actions will be performed to determine if additional munitions are present. The second phase of the removal action will consist of excavation of burial pits, if present, and additional DGM surveys in areas with large anomalies that could mask more deeply buried munitions and a mag and dig removal action in areas where there aren't large anomalies. If additional 20mm projectiles or larger munitions are found during phase 2 of the removal action, additional removal actions will be conducted until no more 20mm projectiles or larger munitions are recovered.

Identification of Inputs that Affect the Decision (Required Information Inputs)

- USGS DGM data collected in 2009, including anomaly counts.
- Type of MEC or MD recovered during intrusive investigation and removal of anomalies.
- If munitions are found, a second removal action phase will be conducted to remove additional munitions that may be found. The second phase may consist of:
    - DGM surveys with reacquisition and intrusive investigation of all anomalies to the maximum EM61-MK2 detection depth.
    - Excavation of munitions burial pits.
    - Analog mag and dig removal actions around individual 20mm projectiles or larger munitions outside of areas with large anomalies.

Specification of the Domain of the Decision (Input boundaries)

- Horizontal Input Boundary
    - Seven acre area adjacent to the STP where geophysical data has been previously collected
- Vertical Input Boundaries
    - The maximum depth of detection of the 20mm projectile for the EM61-Mk2, which will be determined through static testing during the removal action fieldwork.
    - Depth of the intrusive investigation will be sufficient to resolve anomalies, but will not exceed a maximum vertical extent of 4 ft below ground surface (bgs) and intrusive digs will be stopped if bedrock is encountered. If anomalies have not been recovered after digging to 4 ft bgs, this information will be communicated to the USACE.

Input constraints:

Development of a Logic Statement (Analytical Approach)

- All anomalies with a channel 2 response greater than 7 millivolts (mV) and a normal decay (i.e., Channel 1 > Channel 2 > Channel 3) will be intrusively investigated and removed.

- Ten percent of anomalies with a channel 2 response between 5 mV and 7 mV will be intrusively investigated and removed. If any 20 mm projectiles or larger munitions are found in this group, a root cause analysis will be performed and corrective action implemented.
- If 20 mm projectiles or larger munitions are found, then a second phase of removal action will be conducted in the area where the munitions were found.
- If a burial pit of 20 mm projectiles or larger munitions are found, then the full horizontal and vertical extent of the burial pit will be excavated.
- Initial static testing of 20mm projectiles will be used to generate sensor response curves to determine the maximum depth of detection for the EM61-MK2.
- Initial testing of the analog geophysical sensor will be performed at an instrument test strip to verify that it is capable of detecting a small Industry Standard Object (ISO) and a 20mm projectile from the site in horizontal orientation to at least a depth of 6 inches bgs.

Establishment of Constraints on Uncertainty Performance Criteria)

- Anomaly reacquisition within 1.5 meter accuracy
- All analog geophysical instrument operators will be initially tested at an instrument test strip to demonstrate technical competence and ability to operate and detect anomalies to the instrument's maximum detection depth.
- Daily geophysical instrument checks will be conducted and documented on field forms. All seed items in the test strip will be detected by the operator and sensor.
- New geophysical data will meet or exceed the performance metrics contained in Appendix I and USACE Data Item Description (DID) WERS-004.01.

Optimization of Design for Obtaining Data (Plan for Obtaining Data)

- Intrusive investigation of the anomalies as follows:
    - All anomalies with a channel 2 response greater than 7 mV that have a normal decay (i.e., Channel 1 > channel 2 > channel 3),
    - 25% of anomalies with a channel 2 response greater than 7 mV and non-normal decay (i.e., channel 2 > channel 1 or channel 3 > channel 2). If 20mm projectiles or larger munitions are identified, a root cause analysis will be performed and additional anomalies may be added to the dig list.

    - 10% of all anomalies between 5 and 7 mV. If 20mm projectiles or larger munitions are identified, a root cause analysis will be performed and additional anomalies may be added to the dig list.
- If 20 mm projectiles or larger munitions are identified, a second phase of the removal action will be conducted as follows:
    - Munitions burial pits will be excavated to their full horizontal and vertical extent.
    - A 10-ft x 10-ft analog mag and dig removal action will be conducted centered on any individual munitions located outside of the southwestern, large anomaly area.
- Map surface and subsurface anomaly density and distribution using the DGM data and any newly collected analog data.

SWMU 40 DQOs

Statement of Problem

Determine the presence or absence of MEC based on the statistical sampling of anomalies identified within the existing digital geophysical data.

Identification of a Decision the Addresses the Problem (Project Goals)

Determine the nature of anomalies within the subject areas, i.e. previously surveyed areas adjacent to Buildings 12, 13 and former Building 29.

Identification of Inputs that Affect the Decision (Required Information Inputs)

- USGS DGM data collected in 2009, including anomaly counts, randomly selected from the larger dataset
- Intrusive investigation of selected anomalies in the DGM data based on statistical sampling of the total data set

Specification of the Domain of the Decision (Input boundaries)

- Horizontal Input Boundary - areas adjacent to Building 12, 13 and the former Building 29 site were geophysical data has been previously collected.
- Vertical Input Boundaries
    - The maximum depth of detection for the selected investigation instrument
- Depth Input Boundary

- Depth of the intrusive investigation will be sufficient to resolve anomalies, but will not exceed a maximum vertical extent of 4 ft bgs and intrusive digs will be stopped if bedrock is encountered.

Input constraints:

Development of a Logic Statement (Analytical Approach)

- Intrusively investigate the randomly selected anomalies meeting the selection criteria and identify the anomaly as MEC, MD, or other debris
- Initial testing of the analog geophysical sensor will be performed at an instrument test strip to verify that it is capable of detecting a small ISO in horizontal orientation to at least a depth of 6 inches bgs.

Establishment of Constraints on Uncertainty Performance Criteria)

- Anomaly reacquisition within 1.5 meter accuracy
- All DGM data was determined to meet or exceed the QC performance metrics for digital methods IAW DID WERS-004.01
- All analog geophysical instrument operators will be initially tested at an instrument test strip to demonstrate technical competence and ability to operate and detect anomalies to the instrument's maximum detection depth.
- Daily geophysical instrument checks will be conducted and documented on field forms. All seed items in the test strip will be detected by the operator and sensor.
- Data will meet all of the project's MQOs or performance metrics

Optimization of Design for Obtaining Data (Plan for Obtaining Data)

- Map surface and subsurface anomaly density and distribution using the DGM data and any newly collected analog data.
- Intrusive investigation of selected anomalies in the digital geophysical data based on statistical sampling of the total DGM data set IAW Appendix M 'Statistical Selection of DGM Anomalies for Intrusive Investigation'

4.4 PLANNED ACTIVITIES

Additional field activities are proposed to be performed at SWMUs 10 and 40 in Parcel 11. Specifically, a MEC removal action will be performed at SWMU 10; at SWMU 40, a statistical sampling of anomalies will be conducted to determine whether MEC is present. The planned activities include the following:

- Cultural resources coordination;
- Health and safety;
- Civil surveying;
- Vegetation removal;
- Surface clearance;
- DGM data processing;
- Anomaly selection;
- Anomaly reacquisition;
- Geophysical QC; and
- MEC Removal/Investigation.

Each of these tasks is described further in the below sections and standard Operating Procedures (SOPs) are included in Appendix B.

4.4.1 Cultural Resources Coordination

The Army, in consultation with the Navajo Nation and the Pueblo of Zuni has documented traditional cultural places (TCPs) and other cultural resources within the FWDA boundaries. The Army has entered into a Programmatic Agreement (PA) with both tribes to specify procedures that will be employed during environmental investigation and remediation activities. The location of TCPs and other cultural resources relative to the proposed investigation and remediation locations are not included in this Work Plan, which will be a public document when final. Instead, the consultation process will include review by tribal cultural resource personnel to confirm the presence or absence of identified cultural resources within the proposed investigation and remediation areas. UXOTII or higher personnel will escort and provide anomaly avoidance support for tribal cultural resource personnel as they walk each SWMU prior to the initiation of field work activities to identify the location of unmapped cultural resource locations. Tribal cultural resource personnel will be available to evaluate inadvertently discovered items as described in the PA.

Dr. Adam Graves, a Registered Professional Archaeologist meeting the Department of Interior qualification standards has been assigned to oversee and direct any necessary mitigation steps during field activities.

4.4.2 Health and Safety

The project-specific Accident Prevention Plan / Site Safety and Health Plan (APP/SSHP) is included in Appendix D.

4.4.3 Civil Survey and Mapping Plan

A NM Professional Land Surveyor (PLS), will be utilized to conduct a survey to establish control monuments or survey markers with a minimum of horizontal control Class I, third order accuracy will be established for all new primary control monuments established by the NM PLS. Horizontal control is referenced to NM State Plane NAD83, with units of U.S. survey ft. Staking of control points and points of interest will be accomplished by driving wooden stakes for temporary markers. The surveyed geographic position and State Plane coordinates will be referenced to the primary control monuments established for the project. Vertical control or topography will not be surveyed. Survey control points will be used as real time kinematic (RTK) differential global positioning system (DGPS) base stations within radio line-of-sight to each survey area.

A UXOTII or higher will escort survey personnel and provide anomaly avoidance support, as needed, for survey work. Anomaly avoidance procedures are discussed below in Section 4.4.10.2. Pertinent information related to items potentially recovered during the survey related anomaly avoidance process will be entered into the GIS database and included in the Parcel 11 RFI Report.

4.4.4 Vegetation Removal

Limited vegetation removal will be performed within the Parcel 11 SWMU 10 and 40 areas to facilitate MEC investigation and removal operations; however, it is expected limited light vegetation removal will be required. When limited vegetation removal is required, the Army will coordinate with the Tribes, FWDA, and stakeholders prior to removing vegetation to comply with vegetation removal restrictions. The UXO team will clear vegetation using hand-tools or machinery. Vegetation will be cut no closer than six inches from the ground surface using weed whackers for low-lying vegetation and bush hogs or chain saws for thicker vegetation. During any vegetation removal, strict attention will be given so as not to remove any root ball of the vegetation being cut. The UXO technicians that cut the vegetation will wear personal protective equipment (PPE) as required by USACE Engineering Manual (EM) 385-1-1. Cut

vegetation will be removed from the immediate work area and placed outside of the area and allowed to degrade naturally at the project site. The Senior UXO Supervisor (SUXOS) will coordinate with FWDA personnel to determine the optimal location(s) to place the vegetation removed from the clearance area. Prior to, and during vegetation removal, UXO technicians will visually search the area where the vegetation will be removed to ensure the area is free of surface MEC items or other items that may present a physical hazard. During the brush removal, the site personnel will utilize all the safety and health PPE specified in the APP/SSHP, which is included in Appendix D of this work plan.

4.4.5 Surface Clearance

The UXO team will perform a surface clearance of MEC, MD, and scrap metal across the entire SWMU 10 and around the anomalies selected for intrusive investigation in SWMU 40, if needed. The surface clearance will be performed by qualified UXO teams utilizing the detector-assisted surface clearance procedures stated in SOP-601 (Appendix B). All metallic items on or protruding through the surface will be removed during surface removal activities. Any MEC related items and/or metallic debris will be managed IAW the applicable SOPs located in Appendix B.

MEC, material potentially presenting an explosive hazard (MPPEH), and scrap metal will be inspected on-site. Items that can be certified explosive free will be placed in secured containers for disposal/recycling. Items that cannot be certified as explosive free will be managed as material documented as an explosive hazard (MDEH) IAW SOP-207, Appendix B. If MEC or MPPEH items are encountered during the surface clearance, they will be disposed of IAW SOP-207, Appendix B. The UXOTIII will take photographs of MEC and MPPEH and record all MEC, MPPEH, and MD data utilizing a handheld Trimble GeoXT and tablet data recording device.

4.4.6 DGM Data Processing

The existing USGS geophysical data was processed and analyzed using Geosoft's Oasis Montaj, including the UX-Process and UX-Detect Modules to develop dig lists for SWMUs 10 and 40. The data was processed to remove instrument drift and latency. Once the data was processed, grids were created of the Channel 2 response via the kriging method and selected anomalies using UX-Detect's Blakeley Test. The DGM data was processed and anomaly selection criteria were established to determine anomalies potentially representative of MEC or metallic debris the size of a 20mm or larger. Specific anomaly selection criteria are further described in the SWMU specific sections below. The DGM data was processed IAW DID WERS-04.01, EM 200-1-15 and the "Ordnance and Explosives Digital Geophysical

Mapping Guidance Operational Procedures and Quality Control Manual (DGM QC Guidance)" (USAESCH, 2003). Additional details on DGM data processing are provided in SOP-604 in Appendix B.

4.4.7 Anomaly Selection Criteria and Dig Sheet Development

4.4.7.1 *Anomaly Identification and Dig Selection Criteria*

Based on the data, the optimum anomaly selection criteria (time gate and selection threshold) data gridding method, and contour level selection with background shading and analysis were determined. Any changes to the selection criteria will require a field change request.

4.4.7.1.1 Preliminary Anomaly Selection Criteria

All signal peaks that exceed the threshold on the processed channel 2 will be selected as potential anomalies representing UXO (e.g., 20mm, etc.). The sensor response curve for the expected 20 mm munitions items at each SWMU and noise measurements will be used to confirm or refine these preliminary anomaly selection criteria. The Naval Research Laboratory's (NRL's) *EM61-MK2 Response of Standard Munitions Items* (NRL, 2008) contains response curves for many common UXO; however, it doesn't include the response curve for 20mm projectiles. On previous projects, NRL's response calculator was used to determine the EM61-MK2 response to the 20 mm projectile for the most favorable orientation (MFO), or vertical orientation. EM61-MK2 responses above 10 mV could not be acquired at that time at more than one depth and therefore, couldn't calculate a theoretical response curve for the least favorable orientation (LFO), or horizontal orientation. During fieldwork, static tests will be performed using the 20 mm projectile in the LFO and at several depths to attempt to calculate a sensor response curve that can be used to determine the maximum depth of detection of the 20mm projectiles.

Figure 4-1 shows the 20mm projectile MFO sensor response curve and also shows the background root mean square (RMS) noise, 5x RMS noise, and 7x RMS noise levels that are calculated in Table 4-1. Because the USGS didn't collect a background RMS noise line at an instrument verification strip (IVS), the mean and standard deviation of the EM61-MK2 channel 2 background response at 15 locations spread throughout the SWMU 10 20mm projectile area have been calculated. After determining these values, the RMS noise, 5x RMS noise, and 7x RMS noise values were calculated. The average background RMS, 5x RMS noise, and 7x RMS noise values are 1.28, 6.42, and 8.99 mV, respectively. USACE Interim Guidance Document (IGD) 14-01 states that target selection thresholds are "...typically five to seven times the RMS noise." In this case, the noise levels vary considerably across the site. The

minimum potential threshold is 6.42 mV on Channel 2; however, a targeting threshold of 7 mV to minimize the amount of "no-finds" is recommended. The practical anomaly selection threshold corresponds to an anticipated maximum detection depth of 11.6 inches in the MFO. The maximum detection depth in the LFO is not currently known, but test pit measurements will be taken during the field effort to determine this value.

FIGURE 4-1: 20MM PROJECTILE STATIC RESPONSE CURVE

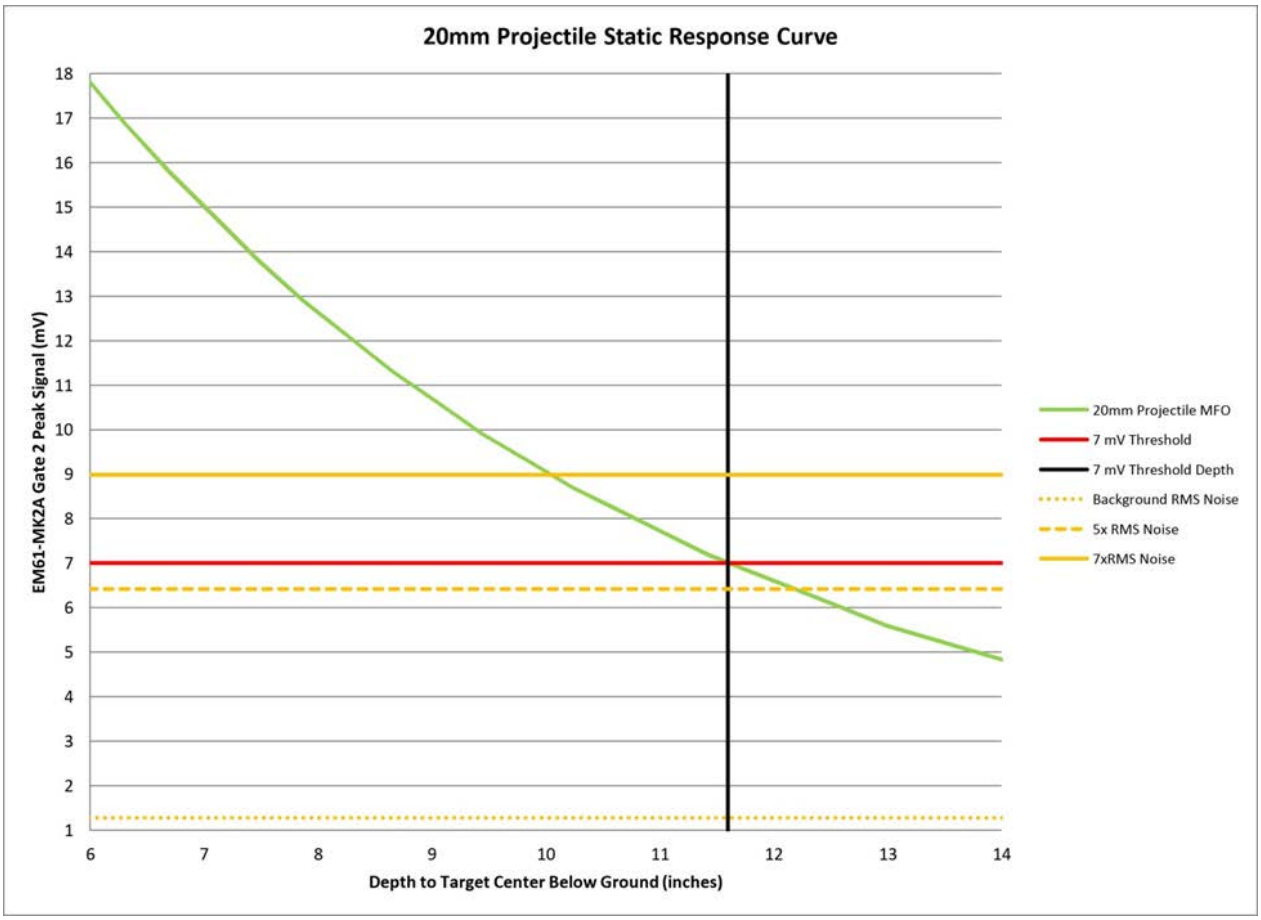


Table 4-1: SWMU 10 RMS Noise Calculation

Area[1]	Line	Mean	STD DEV (mV)[1]	RMS Noise[2]	5x RMS Noise (mV)[1]	7x RMS Noise (mV)[1]
Area 3	61	0.12	1.15	1.16	5.79	8.11
	256	1.49	0.94	1.76	8.80	12.32
	129	-0.07	0.88	0.88	4.41	6.17
	205	0.04	0.88	0.88	4.38	6.14
	323	0.51	0.89	1.02	5.12	7.17
Area 4 Pt1A	5	-0.75	1.29	1.49	7.45	10.43
	8	-0.64	1.73	1.85	9.23	12.92
	40	-0.08	1.48	1.49	7.43	10.40
	48	-0.70	1.58	1.73	8.65	12.11
	53	0.74	1.09	1.31	6.57	9.20
Area 4 Pt2A	71	0.57	0.75	0.94	4.71	6.59
	83	0.42	0.81	0.91	4.57	6.40
Area 5	1	0.66	0.84	1.07	5.35	7.49
	25	0.94	1.03	1.39	6.96	9.75
Avg		0.14	1.12	1.28	6.42	8.99

[1] - Area designations are from the USGS and roughly correlate to: Area 3 - southern 75% of the SWMU 10; Area 4 Pt 1A and Pt 2A - northwestern 12.5% of the site; Area 5 - Northeastern 12.5% of the site.

4.4.7.1.2Anomaly Decision Criteria

The Site Geophysicist will review geophysical data to ensure anomalies with responses equal to or greater than the anomaly selection threshold and those that exceed other anomaly selection criteria are included on the dig list. The anomaly selection criteria are unique for each SWMU and further discussed in Sections 5.0 and 6.0.

All SWMU 10 DGM anomalies (100%) meeting the selection criteria (further detailed in Section 5.4) will be included on the dig list. Additional anomalies will be selected to verify the anomaly selection process. The SWMU 40 dig list represents a statistical sampling of the DGM anomalies which meet the selection criteria. Anomaly peaks that are not automatically selected will be added manually. The Site Geophysicist may add anomalies to the dig list that are not automatically selected and combine multiple anomaly selections that result from double peaks associated with long objects oriented in the direction of travel. Additional anomaly selection criteria may include time constant ranges, full width at half maximum, and spatial distribution factors, etc. These other criteria will be evaluated as the feedback process develops. The anomalies selected for removal and/or intrusive investigation will be annotated as such and target databases will be provided to the project team for concurrence. Anomaly selections, dig

selections and intrusive investigation results will be included in the Microsoft Access (DID Access) Database.

4.4.7.2 *Dig Sheet Development*

Dig sheets will be constructed IAW USACE protocol and will be augmented to include all anomaly selection parameters. The list of anomalies selected for removal and intrusive investigation will be provided to USACE for concurrence. Anomaly selections, dig selections as well as removal and intrusive investigation results will be included in the Microsoft Access (DID Access) Database.

The Site Geophysicist will export the anomaly database from Geosoft Oasis Montaj to Excel and will verify the Excel file is in the proper format and is populated with the correct dig list results, including at a minimum: a unique anomaly ID; X location; Y location; peak value in mV; and any additional anomaly selection parameters. The Senior Geophysicist will review the dig list for completeness and format and deliver it to the GIS department for incorporation into the project database. The GIS department will ensure that all anomaly locations are appropriate and useful and will create target maps. The Senior Geophysicist will review all target maps and then deliver the dig list and target maps to the task leader for incorporation into project submittals.

4.4.8 Anomaly Reacquisition and Resolution Procedures

4.4.8.1 *Anomaly Reacquisition*

Once the dig list is approved the geophysical and intrusive teams will mobilize to Parcel 11 for anomaly removal (SWMU 10) and intrusive investigation (SWMU 40), respectively. The field team will load the dig list files into the RTK DGPS survey controller for reacquisition. The field team(s) will follow the details provided in SOP-605 DGM Target Reacquisition (Appendix B), including refining each anomaly location with a Geonics EM61-MK2 to optimize the initial dig location and to help ensure that the selected anomaly is the one reacquired and marked.

4.4.8.2 *Feedback Process*

The Senior Geophysicist will review the results of each recovered anomaly and assess its validity with respect to signature amplitude, spatial extent, and location, as tabulated on the Dig Sheets. The review will determine whether the metallic items detected were removed and whether there are any noticeable patterns of successes (e.g., “ordnance finds have these parameters in common”) or failures (e.g., “no finds have this parameter in common”). The observations will be documented so future operations can benefit

through a feed-back process. Additionally, any observations determined to be due to field procedure error will be communicated directly to the field teams for recheck to improve current operations.

4.4.8.3 *Anomaly Resolution*

Anomaly resolution sampling will be performed IAW DID WERS-004.01. Within each lot, the number of anomalies selected for resolution will be calculated to ensure a 90% confidence level that less 1% of anomalies are unresolved. This is the default value in IGD 14-01 (USACE, 2013) for removal actions.

The anomaly resolution process will ensure the anomaly peak is removed to below the anomaly selection threshold for the entire anomaly footprint to avoid leaving behind potential munitions. The EM61-MK2 will be used to verify that the anomalies have been resolved. Anomaly resolution sampling will occur after intrusive work within each lot, i.e. one day of anomaly removal or intrusive investigation of data has been completed.

Within SWMU 10, the Senior Geophysicist will select anomalies at random for verification in the field. Anomalies will fail the anomaly resolution process if the peak of the anomaly is still above the anomaly selection threshold and there is not a documented rationale for the remaining response (e.g., underground metallic pipe). If one of the anomalies selected for anomaly resolution within a lot fails, then the entire lot of data preliminarily fails. This will prompt a corrective action response to identify the source of the failure. If the source of the failure can't be explained, then the lot of data will fail and additional anomaly resolution sampling will be required.

4.4.9 MEC Removal/Investigation

4.4.9.1 *General Methodology*

The UXO teams will investigate/remove each anomaly indicated on the dig list generated by the Site Geophysicist. Excavation of anomalies will be performed IAW the procedures outlined in the following subparagraphs and the applicable SOPs located in Appendix B.

Throughout the excavation, the UXO technicians will use a handheld analog sensor to predict proximity to the anomaly. Anomalies will be pursued to the depth of detection or bedrock the excavation, removal of the selected anomaly will be verified using the same type of sensor used to select the anomaly.

Additionally, the post-dig mV reading will be recorded for each excavation. Once the excavated material(s) have been carefully documented, photographed, and inspected, they will be placed in a collection point designated at each SWMU. Any MEC identified will be inspected to determine whether it is safe to move, and addressed IAW with the procedures described below. Anomaly investigative locations will then be systematically evaluated by the UXOQCS IAW the project QC Plan located in Appendix G.

4.4.9.2 *Anomaly Avoidance Procedures*

UXO safety escorts will be embedded in each non-UXO team (e.g., target reacquisition, brush cutting, and civil surveying teams) to implement UXO anomaly avoidance procedures IAW SOP-602 Anomaly Avoidance (Appendix B) and ensure the safety of all site workers. Prior to conducting brush cutting and reacquisition, the UXOTII or higher will verify that an area is clear of any explosive hazards. When ground disturbance is required for non-UXO intrusive operations (e.g., driving survey stakes), a UXOTII or higher will conduct anomaly avoidance to ensure the location is anomaly-free prior to ground disturbance. The UXOTII or higher will sweep a magnetometer (Schonstedt or similar device) above and within a three-foot radius of the ground disturbance location. If subsurface anomalies are identified, the location will be moved to an anomaly-free location to ensure personnel safety. The UXOTII or higher will also escort and maintain a safe access and egress route for all non-UXO personnel on site by walking ahead of all non-UXO personnel to ensure the ground is free of MEC.

4.4.9.3 *Accountability and Records Management for MEC*

A detailed account of all MEC and other materials encountered during the investigation will be recorded on a tablet data recording device. A log entry of all MEC-related materials located in transects or grids will be made in the database indicating amount, identification, condition, depth, and disposition. A log entry will be made for other materials, indicating the general types of materials encountered and pounds excavated.

4.4.9.4 *Personnel Qualifications*

UXO personnel will meet the requirements set forth in the Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP)-18, “Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel” (DDESB, 2004) and OSHA 29 Code of Federal Regulations (CFR) 1910.120. Field teams will consist of a mix of UXO technicians and other personnel depending on the specific scope of the work area.

Each UXO team will consist of one UXOTIII, two UXOTIIs, and four UXOTIs. The UXO teams will be overseen by site management that includes the SUXOS, UXO Safety Officer (UXOSO), and UXO Quality Control Specialist (UXOQCS).

4.4.9.5 *MEC Removal/Investigation Locations*

The DGM Team will reacquire anomalies listed on the approved dig list IAW the procedures outlined in Section 4.4.8 and SOP-605 DGM Target Requisitioning of this Work Plan (Appendix B). The minimum separation distances (MSDs) and Munition with the Greatest Fragmentation Distances (MGFDs) applicable during removal and investigation processes for each SWMU are stated in the Explosive Safety Submission (ESS) for SWMU 10 (Appendix E) and the Explosive Safety Plan (ESP) for SWMU 40 (Appendix F).

4.4.9.6 *MEC Identification*

The MEC identification process will start when the suspected item is located. Reacquired subsurface anomalies will be hand dug by UXO technician personnel to determine the identity of the anomaly. To access the anomaly, UXO technicians will hand dig with a shovel following the procedures outlined in EM 385-1-97, Change 1, Explosives Safety and Health Requirements Manual. At no time will UXO technicians dig directly over an anomaly until its depth has been determined by digging to the side of the anomaly. An excavator may be used for deeper digs but will not be used within 12 inches of the anomaly. Once the anomaly has been located, it will be visually inspected, identified and assessed for hazards by two qualified UXO technicians. If the subsurface contact proves to be non-MEC, it will be removed and the hole will be rechecked with a magnetometer. Investigations will be done to the clearance depths if additional anomalies are detected in the investigation area. Once the hole has been determined not to contain an anomaly within the required clearance depth it will be refilled. All investigation areas will be backfilled and hand tamped. If the contact is MEC, it will be marked and handled IAW the procedures described in EM 385-1-97, Change 1. MEC items will be uncovered sufficiently to obtain a positive identification of the item and to determine whether or not it is fuzed. The UXO technician locating the item will contact the UXOTIII Team Leader and the Team Leader will confirm the items identity. The UXOTIII will evaluate the item and report the identity and condition of the item to the SUXOS or UXOSO. The SUXOS or UXOSO will confirm the identity and condition of the MEC item.

4.4.9.7 *MEC Removal*

Once the item has been identified and marked with a pin flag, the SUXOS or UXOSO will be notified and requested to evaluate whether the item is acceptable to move to one of the CE Igloos or the 10-day CAMU permitted temporary storage area for later destruction at the CAMU IAW this work plan. If the item is determined unacceptable to move it, blow in place (BIP) operations will be conducted. If positive identification of the item cannot be made, the USACE OESS will be notified and assistance requested. The GPS location of each MEC item and all relevant information related to the item will be recorded. Data associated with MEC locations will include:

- Item number assigned.
- Type of item.
- Location of item in coordinates.
- Depth bgs/orientation.
- Digital photograph and disposition.

All MEC items will be secured the same day found through either transportation to a CE Igloo, the CAMU or BIP. However, if an MEC item is found late in the day the item(s) will be marked and if the item is not located in a controlled secure area, a 24 hour security watch will be placed on the item(s) until the proper disposal can be conducted.

MD and other scrap metal removed will be stored in a designated area within the project site in separate, lockable (sealed) containers, MD and scrap metal will not be commingled at any time. The UXO team will perform two independent inspections on each MPPEH item to ensure each are inert and free of energetic material and the SUXOS and UXOQC will certify the process by randomly conducting audits and inspections. Certification by the SUXSO and UXOQCS that the MD are inert and free of energetic material will be made on DD Form 1348-1A. The MDAS inspection and verification process is explained in more detail in SOP-205 Inspection, Disposal and Chain of Custody of Appendix B.

All excavations will be filled in and tamped to the approximate consistency of the surrounding soil. The excavation site shall be returned, as closely as possible, to its original undisturbed condition.

4.4.9.8 *MEC Storage*

If MEC items are identified, they will be handled (e.g., BIP) on the same day, moved to the CAMU or the temporary storage igloos. If the MEC items cannot be disposed of or moved to the CE Igloos or CAMU

on the day it is located (inclement weather, unacceptable to move etc.) it will be marked and if the item is not located in a controlled secure area a 24 hour security watch will be place on the item until it has been disposed of the following day.

4.4.9.9 *Post-Intrusive QC*

The UXO Team Leader will release removal or investigation areas for QC inspection upon completion of removal and/or investigation activities. Detailed QC procedures are provided in the Quality Control Plan (Appendix G). The Senior Geophysicist will review each updated dig list for a final anomaly resolution check. The geophysicist will assess the reported object recovered at each anomaly location against the DGM data. If, in the judgment of the Senior Geophysicist, the recovered object, along with all reported information about the investigation (e.g., object size, quantity, weight, metal type and condition, depth of recovery, any orientation/inclination information, and the Geonics EM61-MK2 remnant signature), matches the DGM data, the dig list will be initialed. In the event the anomaly is not located or the item does not correlate to the DGM data the failure will be processed IAW the Quality Control Plan.

4.4.9.10 *MEC Disposal*

MEC disposal will be IAW the Final Approved ESS (for SWMU 10) and ESP (for SWMU 40) (Appendices E and F) and any subsequent amendments. A copy of the ESS/ESP will be available on site during the duration of the field effort. The SUXOS and UXOSO will follow the procedures that apply to the disposal of MEC.

Demolition operations will be coordinated by the SUXOS and will be conducted IAW the procedures outlined in Department of Army (DA) Technical Manual (TM) 60A-1-1-31, USACE EM 385-1-97, Change 1, Explosives Safety and Health Requirements Manual, MEC Disposal Standard Operating Procedure (SOP-207 Appendix B).

During disposal of MEC, safety is the primary concern. The most obvious requirements are to protect personnel, the general public, and the environment from fire, blast, fragmentation and noise.

4.4.9.10.1 General Demolition Procedures

Detailed demolition procedures are located in the standard operating procedure for MEC disposal (SOP-207 Appendix B). Physical control of the on-site disposal operations will be accomplished by blocking access roads/trails to the site at the point of the exclusion zone (EZ). Control of the disposal operations must be maintained to ensure no unauthorized access of the site by non-essential personnel. During

disposal preparation, all non-essential personnel must evacuate to locations outside the EZ to a designated location, and all essential personnel will be evacuated to a designated location outside the EZ prior to demolition. The maximum fragmentation distance – horizontal (MFD-H) for Parcel 11during disposal operations is specified in the Parcel 11 ESS (Appendix E) or the Parcel 40 ESP (Appendix F).

Prior to preparing MEC for on-site detonation, the UXOSO will ensure that required notifications have been made, and the number of personnel on-site is kept to the minimum required to safely accomplish the disposal task. Appendix C Local Points of Contact contains a listing of personnel to be notified prior to demolition activities and their contact information. It will be ensured that non-essential personnel are evacuated from all buildings within the MFD-H at the time the EZ is established.

4.4.9.10.2 MEC Transportation

In the event it is necessary to transport MEC to the CAMU or CE Igloos the procedures specified in SOP 203, Transportation of Explosives, and SOP 515, Safe Vehicle Operation (Appendix B), will be followed.

4.4.9.10.3 MEC Collection Points

Collection points are those areas used to temporarily accumulate MEC determined acceptable to move by the SUXOS and UXOSO. Consolidating of MEC for this project will be conducted in an area to be determined through coordination with the OESS prior to initiation of field work at each SWMU. These item(s) will be secured until transported to the CE Igloos or the CAMU for a demolition event. MEC items at collection points must be laid out as shown in USAESCH publication Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites, dated August 1998 with terminology update dated March 2000. A copy of the publication will be available on-site. The maximum net explosive weight (NEW) at a collection point will be limited such that the K40 overpressure distance for the total NEW does not exceed the Hazardous Fragmentation Distance for the area.

4.4.9.10.4 CAMU Operation

The CAMU, located in Parcel 3, is operated under the FWDA RCRA permit, RCRA Subpart S (40 CFR 264.552), and Subpart X (40 CFR 264.600), and will be used for destruction and desensitization of MEC by open burning and open detonation. The CAMU is operated IAW the approved permit modification for

destruction and desensitization of MEC (too dangerous to remove from FWDA) determined by the SUXOS, UXOSO, and the OESS.

During periods of operation at the CAMU dry grass, leaves, and other flammable vegetation will be removed for a distance of at least 200 ft from the treatment units. Live vegetation will not be allowed to exceed a height of six (6) inches within 200 ft of the treatment units. The CAMU will be cleared at the conclusion of each treatment by visually clearing the dirt in the pit and removing the resulting ash after each burn, and all scrap and MD after each detonation.

Designated temporary storage area(s) for recovered MEC will be located within the CAMU and will be used only if treatment and disposal processes are delayed. The temporarily stored materials will be treated/disposed of as soon as the next treatment/demolition day can be scheduled. At no time will items be held within the CAMU for more than ten (10) calendar days. Any materials placed in the designated temporary storage area will be properly segregated and stacked in a manner that will minimize the possibility of spreading contamination. This area (i.e., Parcel 3) provides the required security measures, as it is within a locked and controlled double fence. The FWDA caretaker contractor performs security checks of the area, as required.

The amount of MEC treated at the CAMU will not exceed 200 pounds NEW per event. Treatments will not exceed 1,000 pounds NEW in any seven-day period.

Processed scrap metal or munitions debris will be certified as MDAS and transported off-site for smelting IAW all local, state, and federal regulations, respectively as discussed in SOP 205 Inspection, Disposal and Chain of Custody (Appendix B).

4.4.9.10.5 Coordination and Supervision

The on-site disposal will be under the direct control of an experienced and trained UXO Demolition Team Leader charged with the responsibility for all demolition activities within the area. The Team Leader, assigned by the SUXOS, will be responsible for training all personnel regarding the nature of the materials handled, the hazards involved, the precautions necessary, and will be present during all on-site disposal operations. The Team Leader will also maintain custody of the blasting machine for electric or shock tube firing system initiator for NONEL. The SUXOS and Team Leader will ensure that the appropriate authorities are notified prior to on-site demolitions. The SUXOS will ensure that all team

members review and execute all related work IAW all applicable SOPs, which are included in Appendix B of this Work Plan.

The SUXOS and UXOSO will be on site at all times during disposal operations. The operation is performed under the direction and supervision of the SUXOS. The UXOSO monitors compliance with the safety measures contained in the Work Plan and associated documents, and in case of noncompliance, is vested with the authority to stop or suspend operations. Individuals will report the completion of tasks to the SUXOS. The following tasks are required:

- Secure all access roads to the area;
- Visually check demolition site for any unauthorized personnel;
- Check firing wire for continuity and shunt;
- Prepare designated shots;
- Check continuity of detonators;
- Secure the detonators in a safe location, and
- Place charge in desired location.

4.4.9.10.6 General Detonation Operations and Safety Procedures

Disposal activities are inherently hazardous and require strict adherence to approved safety and operational procedures. During disposal operations, all safety measures will be followed as stated in SOP-207, MEC Disposal, included in Appendix B.

Prior to conducting a disposal operation, the Demolition Team Leader will conduct a safety briefing to the members of the demolition team. This safety briefing will include, at a minimum, the following topics:

- Phases of the operation;
- Review of explosive handling and precautions;
- Location of safe area;
- Emergency notification procedures;
- Site specific characteristics;
- Type of UXO being destroyed;
- Placement and quantity of counter charge;
- Misfire procedures;
- Post-detonation cleanup of the site;

- Care and handling of explosive materials;
- Personal hygiene;
- Two person rule;
- Potential trip/fall hazards;
- Location of the vehicle;
- Wind direction (toxic fumes), and
- Location of first aid kit and fire extinguisher.

The vehicle engine will be started prior to initiating priming procedures and will be kept running. Telephone or radio communication will be established with emergency response personnel. No radio or cellular telephone transmissions will take place in the vicinity during the positioning or connecting of electrical initiating devices.

4.4.9.10.7 Fragmentation Distance

Fragmentation distances and overpressure distances are based on the net explosive weight of a single demolition item plus the donor charge, as outlined in the MSD calculations provided in the ESS or ESP (Appendix E or F), in Appendix B, and DOD 6055.9-M V7.E4.5.8.3.5.2.1.1. These distances were calculated using DDESB TP 16. The fragmentation ranges are for open, un-barricaded shots.

4.4.9.10.8 Blow-In-Place Procedures

BIP operations will be conducted for all MEC items found unacceptable to move. Disposal operations will be conducted only after all unnecessary personnel have left the area, road guards have been posted, and the required personnel have been notified. Demolition safety and operations will be conducted IAW SOP-207 MEC Disposal (Appendix B) and the standard practices and procedures outlined in TM 60A-1-1-31. MEC items will be positively identified prior to detonation. Electric or NONEL demolition procedures will be employed as the method of choice for all detonations. All detonations holes will be backfilled. Demolition operations will take place when adjacent operations are least affected and weather permitting. The SUXOS is responsible for determining whether minimum safe conditions to conduct demolition operations are met.

4.4.9.10.9 Material Potentially Presenting an Explosive Hazard

When suspected MPPEH is located, the UXO technician locating the item will contact the UXOTIII Team Leader. MPPEH will be properly inspected and verified IAW SOP-205 Inspection, Disposal and Chain of Custody located in Appendix B.

All suspected MPPEH will be 100% inspected by the UXO Field Team. Two separate UXO qualified personnel will conduct the inspections prior to removing any material from the area/grid. At a minimum a UXOTII will conduct a 100% inspection and a UXOTIII will conduct a 100% re-inspection to determine if the item is MDEH or MDAS and ensuring it does not contain an explosive hazard. The MDAS will then be segregated from other scrap and both will be placed in temporary secure staging areas designated at the start of the project.

Items determined to be MDEH will be transported to one of the CE Igloos or the CAMU for destruction unless it is determined to be unsafe to transport. Only MDEH determined to be unacceptable to move will BIP. It is intended that all MDEH items found will be transported on the same day as located. However, if a MDEH item is found late in the day and transportation and/or disposal is not possible the item will be marked and if it is not in a controlled secure area a 24-hour security watch will be placed on the item until proper disposal can be conducted.

The SUXOS and UXOQCS will conduct daily audits of the above procedures for processing MPPEH, including MDEH and MDAS, to ensure they are being conducted as required by this Work Plan, and will further perform random sampling of designated MDAS and MD, by pieces, volume or area, as required to ensure no items containing explosive hazards are being comingled with the inspected material.

4.4.9.10.10 Munitions Debris Inspection and Storage Requirements

Within or adjacent to each investigation area, the UXO team will establish temporary scrap collection points. During intrusive operations, metal scrap will be inspected by a UXOTIII and segregated into the following three categories:

- Other Related Scrap (e.g., nails, wire, tin cans, etc.).
- MDAS (e.g., frag, shrapnel, and ordnance components free of explosives).
- MDEH requiring disposal by explosive demolition operations.

Upon completion of daily operations, the team will collect the other related scrap and MDAS from the temporary collection points for transport to the scrap holding area where it will be inspected and secured

IAW SOP-205 Inspection, Disposal and Chain of Custody (Appendix B). As the material is being loaded, the UXOTIII will perform a second inspection of the material to ensure it is segregated correctly and is free of explosives.

The SUXOS and UXOQCS will perform random spot checks to ensure and verify that the established inspection process is being implemented as required by the Work Plan and all located MDAS being placed in the secure storage containers are free of any explosive hazards and can be maintained in a secure, separate fashion. If security of the lockable storage containers or drums is breached in any way, the contents must be re-inspected as discussed above.

Inspected and certified MDAS will be secured in locked containers or drums until final disposition to prevent comingling with material that has not been inspected. The containers will be secured, sealed and lockable, clearly labeled on the outside with a unique identification that will include FWDA unique numbering requirements including, a sequential number starting with 0001, and the seal's unique identification. Labeling will continue sequentially for each additional container used. The seal will be attached in such a manner that the container cannot be opened without damaging the seal.

Other related scrap will be placed in locked containers or drums for local disposal/recycling. Each container provided to the disposal/recycling facility will include a documented description with the following information: contents, weight, location where scrap was obtained, name of contractor, names of certifying and verifying individuals, container identification number, and seal identification.

4.4.9.10.10.1Personnel Responsibilities regarding Inspection and Classification

Inspection and classification is a critical aspect of MEC operations and only personnel qualified as a UXOTIII or above perform these inspections. The UXO team will ensure that the materials are inspected on the exterior and interior surfaces to be certain that these items do not present an explosive hazard. The team will employ a four-level process for the inspection of MPPEH:

- UXO team inspects MPPEH at the time of excavation;
- UXOQCS inspects MPPEH during daily audits of the procedures used by UXO teams and individuals for processing MPPEH;
- UXOQCS ensures the procedures and responsibilities for processing MPPEH for certification as scrap metal are being followed and performs random checks of processed MDAS, and

- SUXOS/UXOQCS ensures the specifics of the procedures described in the Work Plan and QC Plan are followed to process MPPEH; SUXOS completes the DD Form 1348-1A and performs random checks that the MD are free from explosive hazard; ensures all inspection, certification, and final disposition procedures meet the requirements of the Work Plan.

Specific personnel responsibilities regarding MD and other related scrap inspection and handling follows:

- UXOTIIs:
  - Check, classify and segregate all scrap as they recover it.
- UXOTIIIs:
  - Re-inspect all scrap as it is loaded for transport to the scrap holding area.
- UXOQCS:
  - Conduct daily audits of the scrap metal handling process; and
  - Randomly inspect and document a minimum of 10% of the scrap being processed to ensure the handling procedures are being followed.
- UXOSO:
  - Ensure that specific procedures for scrap metal processing are being followed, performed safely, consistent with applicable regulations, and IAW the Work Plan.
  - Perform random checks to ensure all scrap is being handled correctly.
- SUXOS:
  - Ensure that specific procedures for scrap metal processing are being followed, performed safely, consistent with applicable regulations, and in accordance the Work Plan.
  - Perform random checks to ensure all scrap is being handled correctly.
  - Certify that all scrap metal is free from explosive hazards.
  - Takes responsibility for ensuring all inspected materials are secured in locked containers while awaiting shipment off site.

Ensure that prior to shipping material off site, inspected materials are in a closed, labeled, and sealed container and documented properly.

4.4.10 Geophysical Systems Verification

4.4.10.1 *Introduction*

If DGM surveys are conducted during phase 2 of the removal action, t the GSV process will be implemented IAW the Final Geophysical Systems Verification Report (ESTCP, 2009). The GSV is a key

component of ensuring the DGM data quality is sufficient to meet the project DQO requirements and is used to monitor and verify DGM sensor functionality during the RI geophysical mapping activities.

The GSV approach uses an IVS and a blind seeding program in production DGM grids and transects. It also capitalizes on the known performance of the EM61-MK2 (Naval Research Laboratory, 2008 and 2009). It provides the advantage of reallocating resources traditionally devoted to a Geophysical Prove-Out to support a simplified, yet more rigorous, verification method for the geophysical system operations. In addition, the blind seeding program aids in the continuous monitoring of production mapping work within the MRS.

Although the IVS concept is not directly applicable to analog procedures (because there is no recordable response to verify), UXO technicians will also test their analog sensors at the IVS each day to ensure they obtain a positive response. The sections below provide the GSV procedures and include the following:

- Section 4.4.10.2 GSV Objectives
- Section 4.4.10.3 Instrument Verification Strip
- Section 4.4.10.4 Blind Seeding

4.4.10.2 *GSV Objectives*

The GSV objectives include:

- Demonstrate the geophysical investigation system/equipment, are operating properly;
- Verify the DGM performance metrics;
- Verify IVS seed item detection (100%);
- Identify a Time Gate to use for target selection (*e.g.*, Gate 2 recommended) when using the EM61-MK2;
- Confirm IVS seed item amplitude repeatability IAW the performance metrics in Appendix G;
- Confirm IVS seed item position reproducibility IAW the performance metrics in Appendix G;
- Establish dynamic background root mean square (RMS) noise levels for each Time Gate;
- Establish initial anomaly selection threshold (typically five to seven times the RMS noise value to ensure good signal to noise ratio); and
- Confirm the response for each seed item has a response between the responses for the least and most favorable orientation at its respective depth.

4.4.10.3 *Instrument Verification Strip*

4.4.10.3.1 IVS Design

The approximate IVS location will be identified prior to the start of DGM surveys near SWMU 10. The IVS will be established in an open portion of the site that is relatively free of background anomalies. The DGM survey team will use the Geonics EM61-MK2, operating in the Monitor/Null mode, to select a final IVS location that is sufficiently free of background anomalies, including a line for seed items and a line for dynamic background noise measurements. Once the IVS is located, the DGM survey team will collect and process a pre-IVS background Geonics EM61-MK2 survey to document background conditions.

The IVS will be linearly seeded with three small industry standard objects (ISOs), as well as two nails/spikes at the end of the IVS. The ISOs listed in Table 4-2 are Schedule 80 pipe nipples, threaded on both ends, made from black welded steel and manufactured to an American Society for Testing and Materials (ASTM) specification. The seed items will be buried IAW the proposed IVS layout, each at a depth between the ground surface and the anticipated detection depth.

The ISO seeds will be placed in the IVS and distributed sufficiently (10 ft apart) to prevent overlapping signals. The proposed IVS seed locations are presented in Table 4-2 as distances along the length of the IVS centerline. The items will be buried horizontally (least favorable orientation) and vertically (most favorable orientation). Depths are in inches and are all to the center of the ISO. The DGM team will follow normal anomaly avoidance procedures during the construction of the IVS. Any background anomalies will be avoided.

Seed locations will be surveyed by either the DGM survey team or a Professional Licensed Surveyor licensed in NM. Final seed item locations will be measured with the RTK DGPS rover receiver mounted to a range pole. Final seed item depths will be measured to the nearest half inch from ground surface to the center of each seed item. The item parameters (*i.e.*, the surveyed location, size, depth, orientation) will be recorded and entered into the database. The JV will mark the location of the seed items and start and end points of each IVS transect at the ground surface with polyvinyl chloride pin flags or wooden stakes. In addition, the JV will place survey nails/spikes at each end of the IVS centerline.

Table 4-2: IVS Seed Items

Item	Location along line (ft)	Nominal Pipe Size	Outside Diameter	Length	Depth to Center (in bgs)	Orientation
Nail/spike	0	NA	NA	NA	0	Vertical
Small ISO	10	1”	1.315” (33mm)	4” (102mm)	4	Horizontal along track
Small ISO	20	1”	1.315” (33mm)	4” (102mm)	8	Vertical
Small ISO	30	1”	1.315” (33mm)	4” (102mm)	4	Horizontal across track
Nail/spike	50	NA	NA	NA	0	Vertical

4.4.10.3.2 IVS Procedures

Static measurements will be taken over each item in the IVS prior to the holes being filled in order to ensure the response is as predicted and depth measurements are accurate. On the first day of data collection, the DGM team will collect EM61-MK2 data along five profiles that include:

- Transect spaced one full line spacing (2.5 ft for DGM grids) to the left of the centerline
- IVS Centerline
- Transect spaced ½ line spacing (1.25 ft) to the right of the centerline
- Transect spaced one full line spacing (2.5 ft) to the right of the centerline
- RMS noise line (approximately 15 ft from centerline)

The IVS data from the first day will be evaluated to determine a baseline response and target location for each seed item, as well as the background noise information, to compare against the production surveys.

Daily IVS data will be collected along the center line and the unseeded test strip before and after production DGM surveys. For each IVS survey event, the EM61-MK2 will first traverse the IVS main line over the buried ISOs, then the unseeded background noise line. The data will be processed IAW SOP-604. The IVS seed item instrument responses and target locations from each IVS data collection event will be compared to

the results from the first days' worth of data collection. This comparison will verify that the instrument is operating consistently between the IVS and production surveys.

IVS DGM data will be collected with the sensor deployed in normal wheeled mode with the wide coil edge forward, positioned with the RTK DGPS, and run again positioned with fiducials. The results of these DGM survey lines will be used to:

- Verify seed item response – establishes baseline response for subsequent 2 times daily checks (IVS line 2);
- Verify positioning accuracy for RTK DGPS and fiducial positioning systems (IVS line 2);
- Establish dynamic RMS noise levels (IVS line 4);
- Confirm ISO responses fall within the established least and most favorable response curves and establish seed item response and location error budgets applicable to Blind Seed Item (BSI) detections.

Spreadsheets will be used to track all data files. The IVS centerline data for peak seed item responses will be analyzed on all four time gates. The background line will be analyzed for RMS noise value for each time gate. The RMS noise values will be compared to the peak seed item responses to assess their detectability (*e.g.*, signal peak response to background noise ratio). A selection will be made on the best time gate (Time Gate 2 is expected) and initial threshold (typically 5 to 7 times the background RMS noise value) to select anomalies that will maximize the IVS seed item detections while minimizing background noise anomaly selections in the production grids.

The project field team will review the initial IVS results with the Senior Geophysicist and if all objectives and performance metrics have been met, then a consensus will be made to transition immediately to production DGM. If any objective or performance metric cannot be achieved or agreed upon, a corrective action will be performed and the IVS redone until consensus is reached to proceed to production DGM.

If an instrument does not meet the standard set at the IVS, it will be repaired or replaced. Operational and test procedures will conform to manufacturer's standard instructions. All geophysical instruments and equipment used to gather and generate field data are maintained and checked with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

4.4.10.3.3 IVS Letter Report

The initial results of the IVS will be discussed between the Senior and Site Geophysicists and the USACE QA Geophysicist. The Senior Geophysicist will monitor daily IVS and BSIs for positional accuracy and response and compare them to the initial IVS results. All seed item responses should plot higher than the calculated response curve for the least favorable orientation, after accounting for potential errors. The average noise and background values across the unseeded noise line, will be calculated and monitored during the life of the project. The Senior Geophysicist will catalogue and track the land-based BSIs detected during DGM surveys in the project GIS database and the GSV results will be included for the digital geophysical data packages. The BSIs will also be tracked in the Microsoft Access (DID Access) Database after the processing team selects targets so the BSIs remain blind to the teams.

After the initial IVS fieldwork has been completed and a consensus has been reached to transition into production DGM, the Senior Geophysicist will prepare an IVS data package and an IVS Letter Report including the following:

- As-built drawing of the IVS;
- Seed Item location spreadsheet and all control points (Microsoft Excel format);
- All raw and processed geophysical data, including maps and IVS seed item response profiles; and
- Summary of the IVS results, including daily instrument check results.

The IVS Letter Report will be submitted in draft form within a week of the IVS fieldwork and the final report will be provided two weeks after receipt of comments on the draft report. The final IVS Letter Report will also be included as an appendix to the RI Report.

4.4.10.4 *Blind Seeding*

The UXOQCS, or designee, will blind seed the DGM Survey grids IAW ESTCP's Final GSV Report. The objectives of the blind seed program are to provide ongoing monitoring of the quality of the geophysical data collection and target selection process related to the production survey for the MRS, as well as setting standards for other requirements (*i.e.*, speed, static repeatability, etc.). The UXOQCS will blind seed grids with at least one BSI per team per day. Small ISO80s will be used for BSIs and a NM-licensed Professional Licensed Surveyor or the DGM team will survey the locations of the BSIs with an RTK DGPS. The BSI locations within grids will be blind to the data collection and data processing teams. Because traversal of BSIs is difficult to ensure along geophysical transects, a pin flag will be placed at the location of BSIs along

transects to ensure the geophysical data collection team traverses the BSI. The location of the BSIs along land transects will be blind to the data processing team.

After each data set is collected, the Senior Geophysicist, or his designee, will overlay the locations of the BSI on the processed data and verify that the detection and navigation performance metrics are met (see Worksheet #12 for these metrics). The response of each BSI will be compared against the IVS results and the instrument response curves. The blind seeding requirement will reference and meet the requirements of the Final ESTCP GSV Report. The positional and response acceptance criteria are contained in Worksheet #12.

5.0 SWMU 10 20MM ANOMALY AREA

5.1 BACKGROUND SWMU 10 ANOMALY AREA

To the northwest of the Administration area is the site's incinerator which was used to burn the tracer elements out of practice 20mm munitions. Burned out and rusted 20mm casings have been seen in the area surrounding the incinerator, bordering the eastern end of SWMU 10. The intent of this action is to remove metallic anomalies identified during the RFI as being 20mm in size or larger.

5.1.1 Location, Description, and Operational History

SWMU 10 is the FWDA STP. Figure 5-1 shows the current SWMU 10 structures associated with the RCRA Permit. While this section of the work plan is limited to the approximate 7 acres east of the incinerator, complete background information regarding FWDA and Parcel 11 is provided in numerous document previously submitted to NMED including the following:

- Final - RCRA Facility Investigation Report, Parcel 11, Revision 2, volume 1, 2, 3 - FWDA (USACE, 2014);
- Summary Report of Historical Information, Parcel 11 – FWDA (TPMC, 2009)
- RCRA Facility Investigation Work Plan Final, Parcel 11, Revision (TPMC, 2009)

5.1.2 Conceptual Site Model

The Conceptual Site Model (CSM) for SWMU 10 20mm Anomaly Area is presented in Table 5-1 below.

Table 5-1: SWMU 10 20mm Anomaly Area CSM

Profile Type	Site Characterization
Profile	Area and Layout ▪ SWUM 10 20mm Anomaly Area is approximately 7 acres in size and is located east of the former incinerator
	Structures ▪ Structures currently located in the area include building and features associated with the FWDA STP
	Location ▪ Within Parcel 11, located in the northwest portion of FWDA
	Utilities

Profile Type	Site Characterization
	▪ Limited utility lines are anticipated at the project site. Location of utility lines is unknown; therefore, a utility mark-out may be required prior to conducting any intrusive work at the site. Utility locates will be coordinated with FWDA Caretaker 10 days in advance.
	Security ▪ SWMU 10 is located within FWDA, a secure facility
Land Use and Exposure Profile	Current Land Use ▪ FWDA is in BRAC care taker status undergoing environmental investigation and remediation
	Potential Future Land Use ▪ After environmental remediation, the land will be turned over to BIA and held in trust for the Navajo Nation and/or the Pueblo of Zuni.
	Human Receptors ▪ Receptors include facility caretaker personnel and those conducting environmental investigations and remediation
	Potential Future Human Receptors ▪ Receptors include BIA authorized land users
Ecological Profile	Degree of Disturbance ▪ FWDA provides habitat for moderate grasslands and sagebrush as well as antelope, prairie dogs, rattlesnakes, field mice, various insects and animals. Occasionally mountain lions, elk and bear are present. SWMU 10 has minimal disturbance as past site activities have been discontinued.
Munitions/ Release Profile	Munitions ▪ Munitions potentially present at SWMU 10 include 20mm projectiles, per the RFI.
	Munitions Debris ▪ MD originating from 20mm projectiles were identified during the RFI
	Associated Munitions Constituents ▪ No munition constituents were detected during the RFI.
	Transport Mechanisms / Migration Routes / Pathway Analysis ▪ Based on the information available to date for the SWMU 10 20mm Anomaly Area, there is a potentially complete surface and subsurface exposure route for contact with MEC. There are no drinking water wells or identified munitions constituents in the area therefore no dermal, ingestion or inhalation exposure routes exist for groundwater.

5.1.3 Surface Conditions

SWMU 10 is typically characterized by a flat lying ground surface with several bermed settling ponds. The ground surface is generally gravel or soil covered. There are no defined storm water management structures.

The MEC removal area is generally flat with low to moderate height grasses.

5.1.4 Subsurface Conditions

Geologically, the site conditions for geophysical investigations are good. Geophysical data collected during previous investigation efforts have not indicated unusual geophysical conditions or an unusual quantity of ferromagnetic rocks..

The MEC removal area does not contain any known subsurface utilities. The STP fence is located to the west of the removal area however it is at a distance that is not anticipated to interfere with the geophysical process at SWMU 10.

5.2 PREVIOUS MEC INVESTIGATIONS

5.2.1 USGS EM61-MK2 DGM Survey

During the RFI field work, MD/scrap (e.g. 20mm projectiles) were observed on the ground surface east of the STP. The items were inspected by UXO qualified personnel and no potential explosive hazards were identified. A DGM survey was conducted over approximately 7 acres within and around the surface debris area as show on Figure 5-1.

The DGM survey was performed using the EM61-MK2 in cart mode with a Leica RTK GPS 1200 rover unit mounted on a backpack frame, with the rover unit directly over the center of the cart. For this particular survey, the Leica RTK positional output was set to match the data acquisition rate of the EM61-MK2 which was 10 Hz.

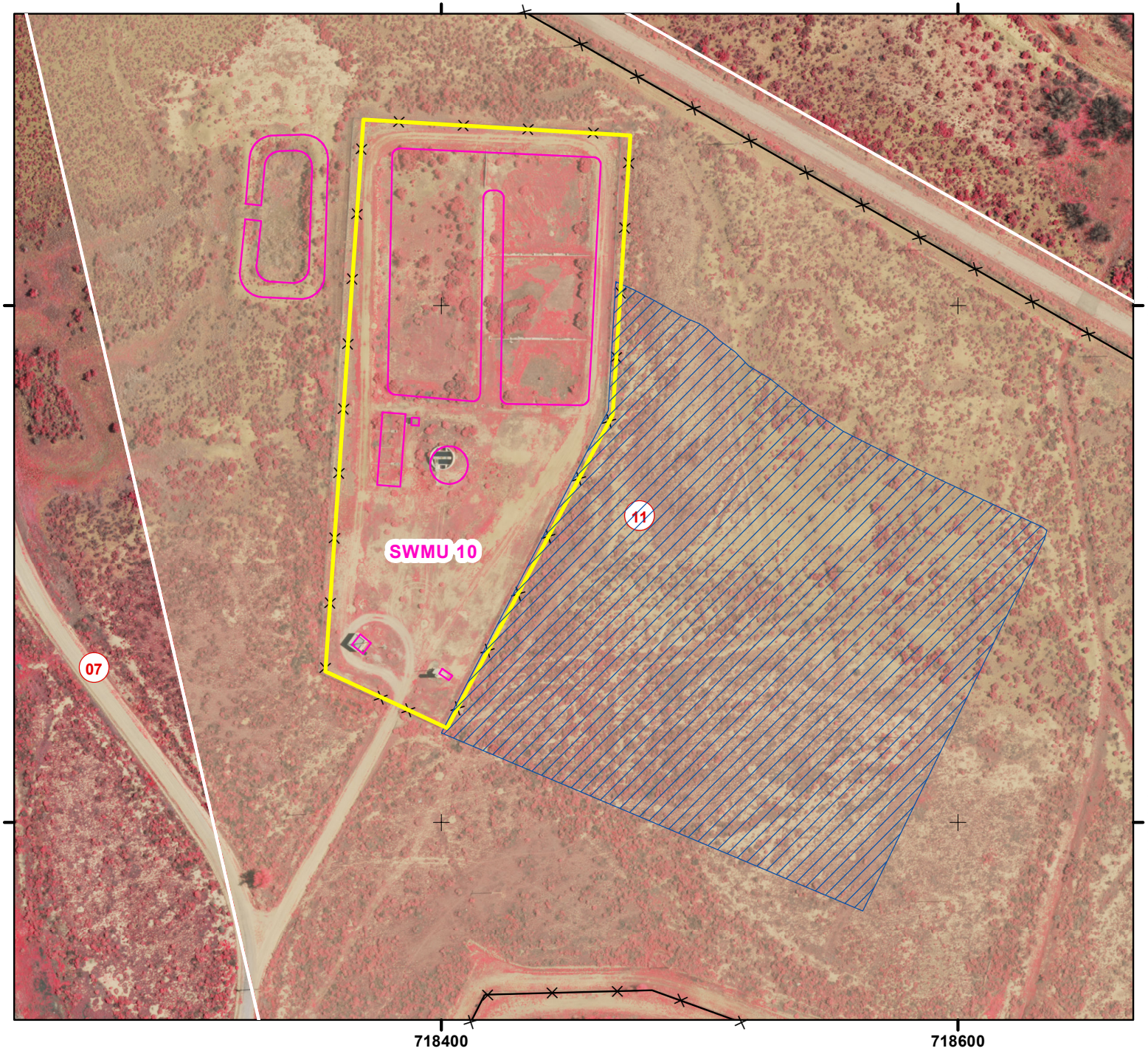
Given the results of the RFI, the Army has determined it is necessary to conduct a removal of the subsurface anomalies with the potential to be 20mm or greater based on the results of the geophysical survey. Figure 5-2 shows the channel 2 response of the DGM survey.

Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 5-1

SWMU 10
Geophysical Survey Area

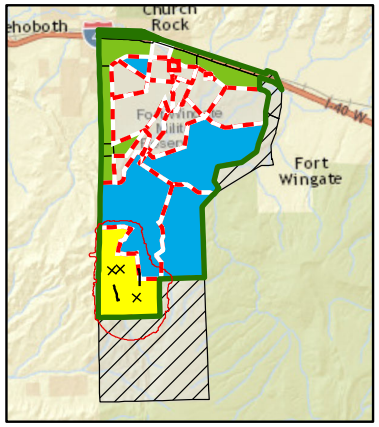


Legend

- Installation Boundary
- SWMU/AOC
- Parcel 11
- Fence
- Structure
- Approximate Extent of Geophysical Investigation

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- 11 Parcel Number



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5.3 INVESTIGATION METHODS

5.3.1 Location Surveys and Mapping Plan

Due to the size of the MEC removal area at SWMU 10, the site will be divided into 100 x 100 ft grids if DGM surveys are conducted. Procedures that will be implemented for location surveys, site mapping and grid layout are specified above in Section 4.4.3.

5.3.2 Anomaly Reacquisition and Resolution Procedures

Procedures for anomaly reacquisition and resolution at SWMU 10 are specified above in Section 4.4.8. Anomalies selected for removal are shown in Figure 5-3.

5.3.3 Geophysical QC Procedures

Procedures for geophysical QC are specified Appendix G.

5.3.4 Intrusive Investigation

Procedures to be implemented during the execution of the removal action are specified above in Section 4.4.10.

5.3.5 Second Phase of Removal Action

If 20mm projectiles or larger munitions are found during the intrusive investigation, a second phase of the removal action will be conducted. As shown on Figure 5-2, the site has been broken up into two different areas: the large anomaly area in the southwestern portion of the site where 20mm projectiles have previously been found, and the remaining areas. Figures 5-3 and 5-4 show the decision logic to determine what types of activities will be conducted within large anomaly area and the remaining areas, respectively. Analog mag and dig and burial pit excavation procedures will follow those outlined in SOP 357 in Appendix B. If DGM surveys are conducted, the surveys will be conducted IAW SOP-603 and data processing IAW SOP-604.

5.4 SCOPE OF ACTIVITIES

All anomalies meeting the anomaly selection criteria will be reacquired and intrusively investigated to detect and remediate 20mm projectiles to the maximum detection depth of the EM61-MK2. Table 5-2 presents a summary of the total number of anomalies and the total number of anomalies that will be intrusively investigated. These anomalies were selected as follows:

- Number of anomalies that exceed the preliminary 5 mV detection threshold: 4,436 total anomalies.
- Number of anomalies that exceed the 7 mV final target selection threshold (Section 4.4.7.1.1 describes the process used to define the 7 mV final selection threshold) that have a normal decay: 2,500 total anomalies.
- Number of anomalies that exceed the 7 mV final target selection threshold that have a non-normal decay that have been selected for anomaly reacquisition and intrusive investigation to QC the decay analysis (25% of all anomalies have been selected initially): 50 anomalies selected out of 200 total anomalies with non-normal decay.
- Number of anomalies between 5 mV and 7 mV that have been selected for anomaly reacquisition and intrusive investigation to QC the anomaly selection threshold (10% of all anomalies have been selected initially): 194 anomalies selected out of 1,936 total anomalies

A total of 2,744 anomalies within SWMU 10 will be investigated. If metal with a size and shape greater than or equal to a 20mm projectile is found at any of the QC target locations, a root cause analysis will be performed IAW the QC plan contained in Appendix G and additional anomalies may be selected for intrusive investigation.

Anomaly resolution sampling will be performed IAW DID WERS-004.01 and Table 5-3, which presents the lots that are proposed for the SWMU 10 removal action, the number of anomalies within each lot, and the number of anomalies that will be resolved for each lot. The number of anomalies selected for resolution was calculated to ensure a 90% confidence level that less 1% of anomalies are unresolved. This is the default value in IGD 14-01 (USACE, 2013) for removal actions.

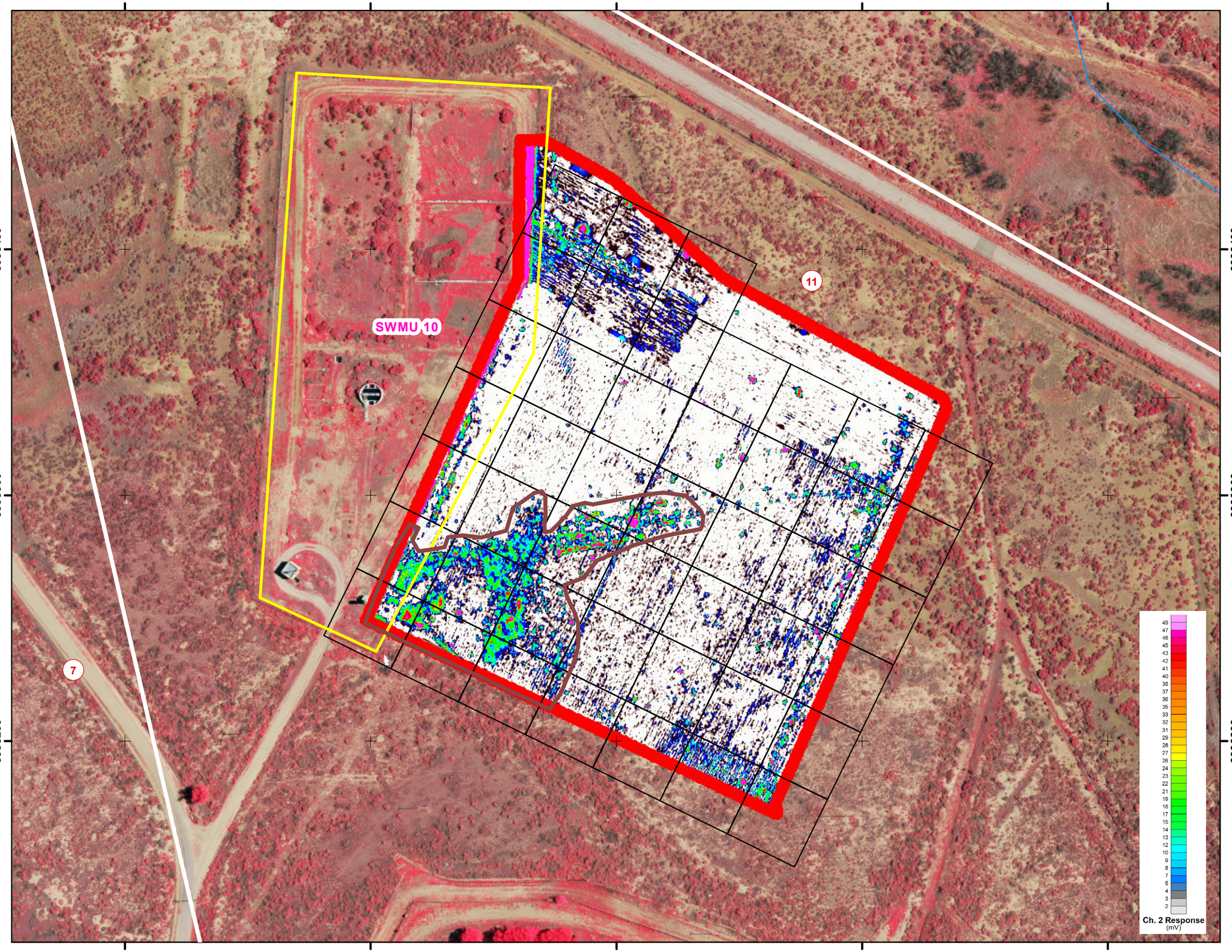
If 20mm projectiles or larger munitions are found during the intrusive investigation, then phase 2 of the removal action will be implemented as soon as possible. The amount and type of investigation performed will depend on the type of munitions found and where those munitions are found. Figures 5-4 and 5-5 will be used to determine the type of investigation required during phase 2 of the removal action. As shown on these figures, if additional 20mm projectiles or larger munitions are found, additional removal actions will be conducted until no more munition equal to or greater in size to 20 mm projectiles are found.

Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 5-2

SWMU 10 Geophysical Data

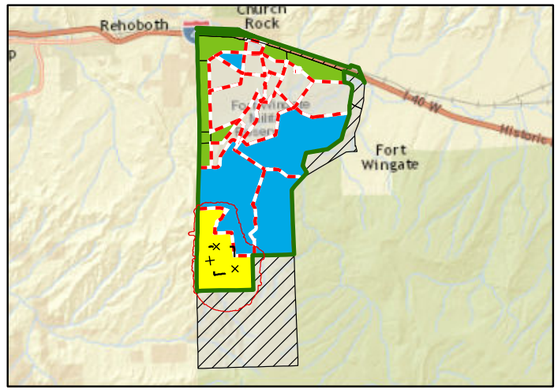


Legend

- SWMU/AOC
- Grid
- Large Anomaly Area in SW

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- 11 Parcel Number



N

0 65 130 260 ft

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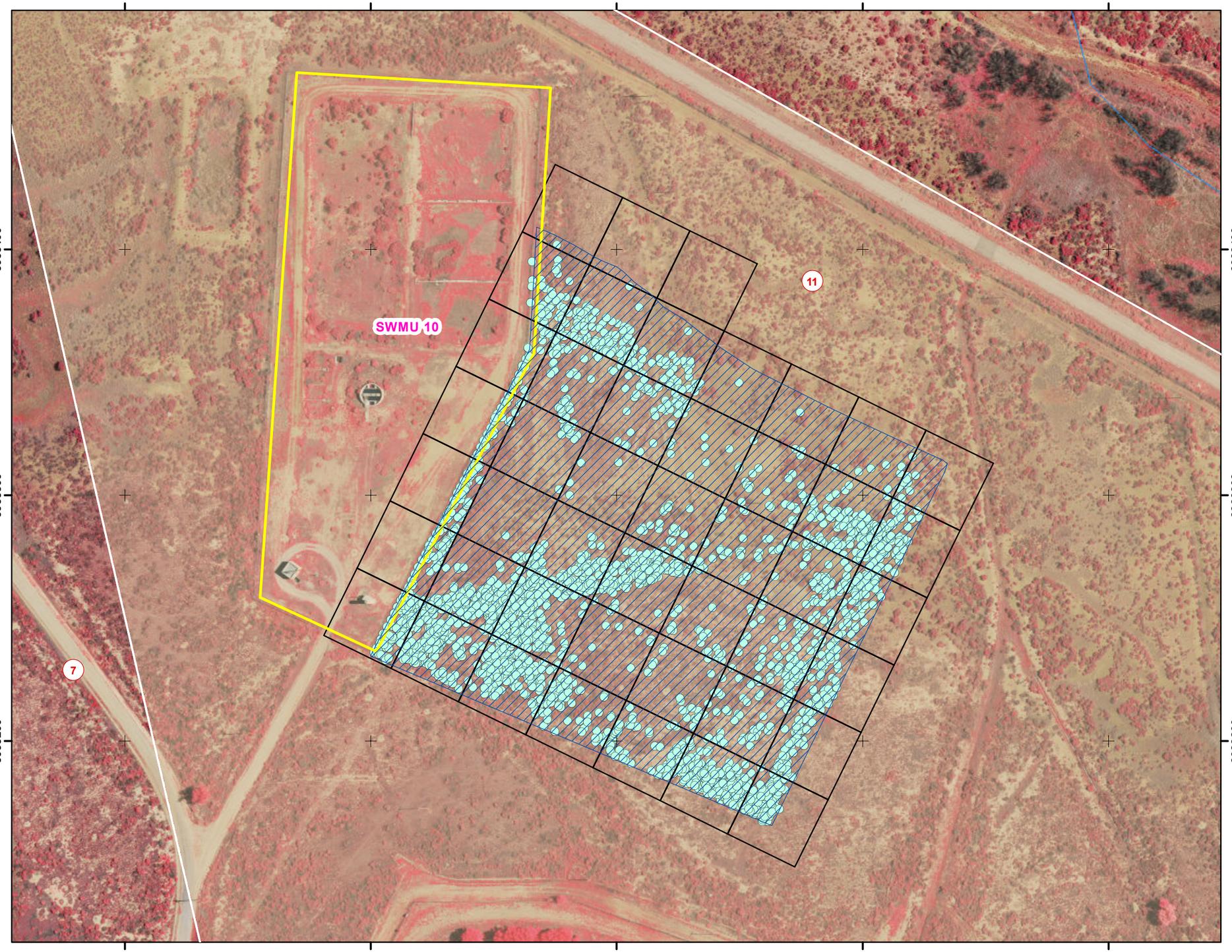
Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 5-3

Parcel 11 SWMU 10 Anomalies for Removal

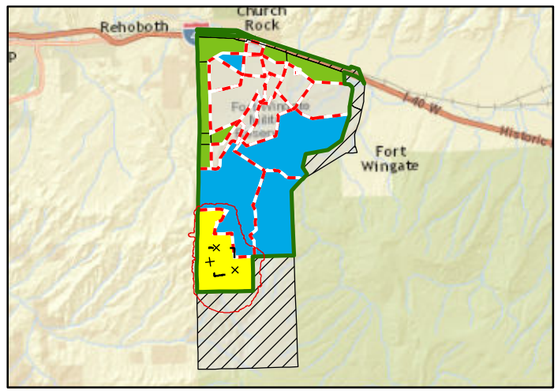


Legend

- SWMU/AOC
- Parcel 11
- Approximate Extent of Geophysical Investigation
- Grid
- Anomaly

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- 11 Parcel Number



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0 65 130 260 ft

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FIGURE 5-4: SWMU 10 LARGE ANOMALY AREA DECISION LOGIC DIAGRAM

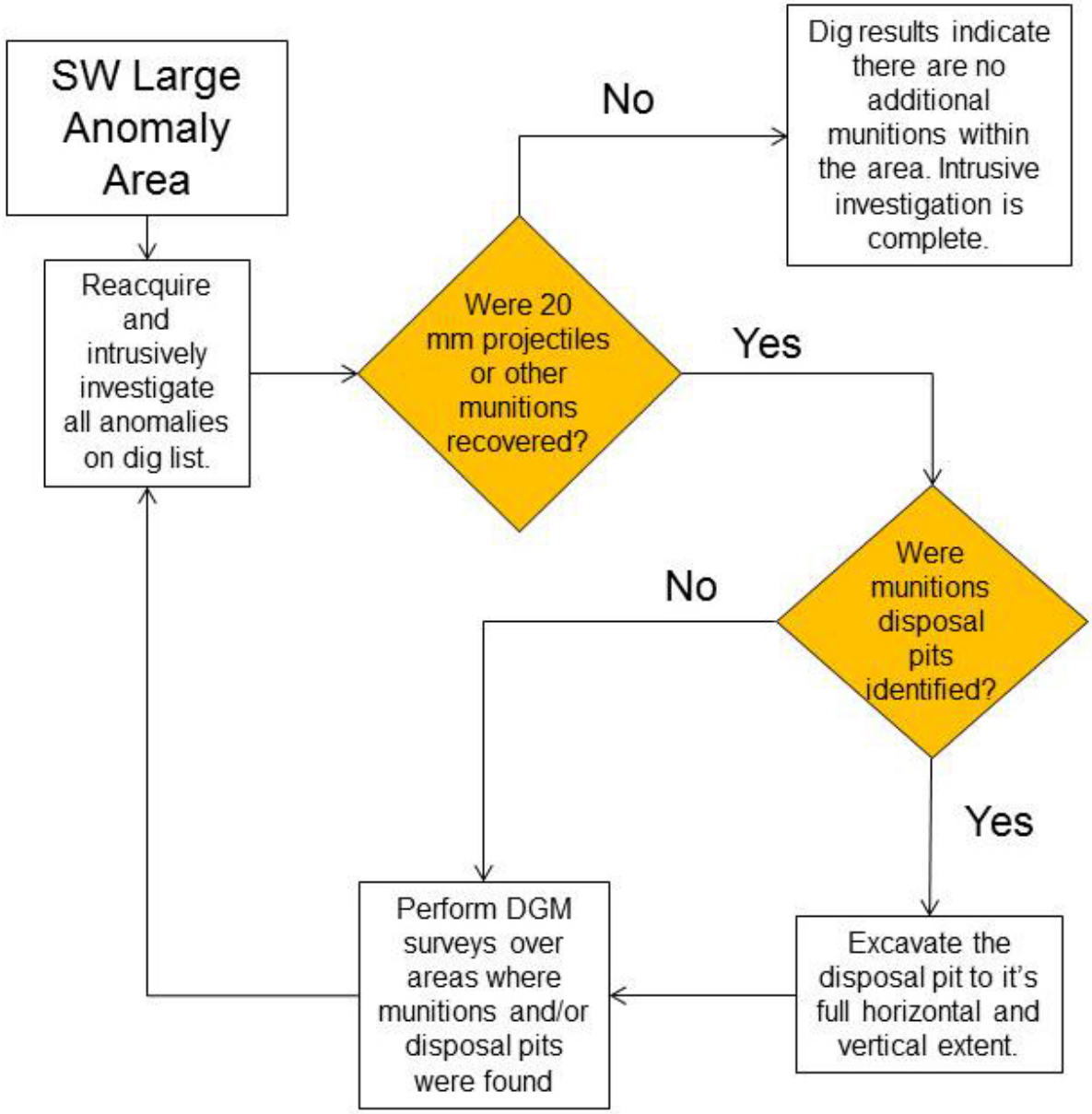


FIGURE 5-5: REMAINING AREA DECISION LOGIC DIAGRAM

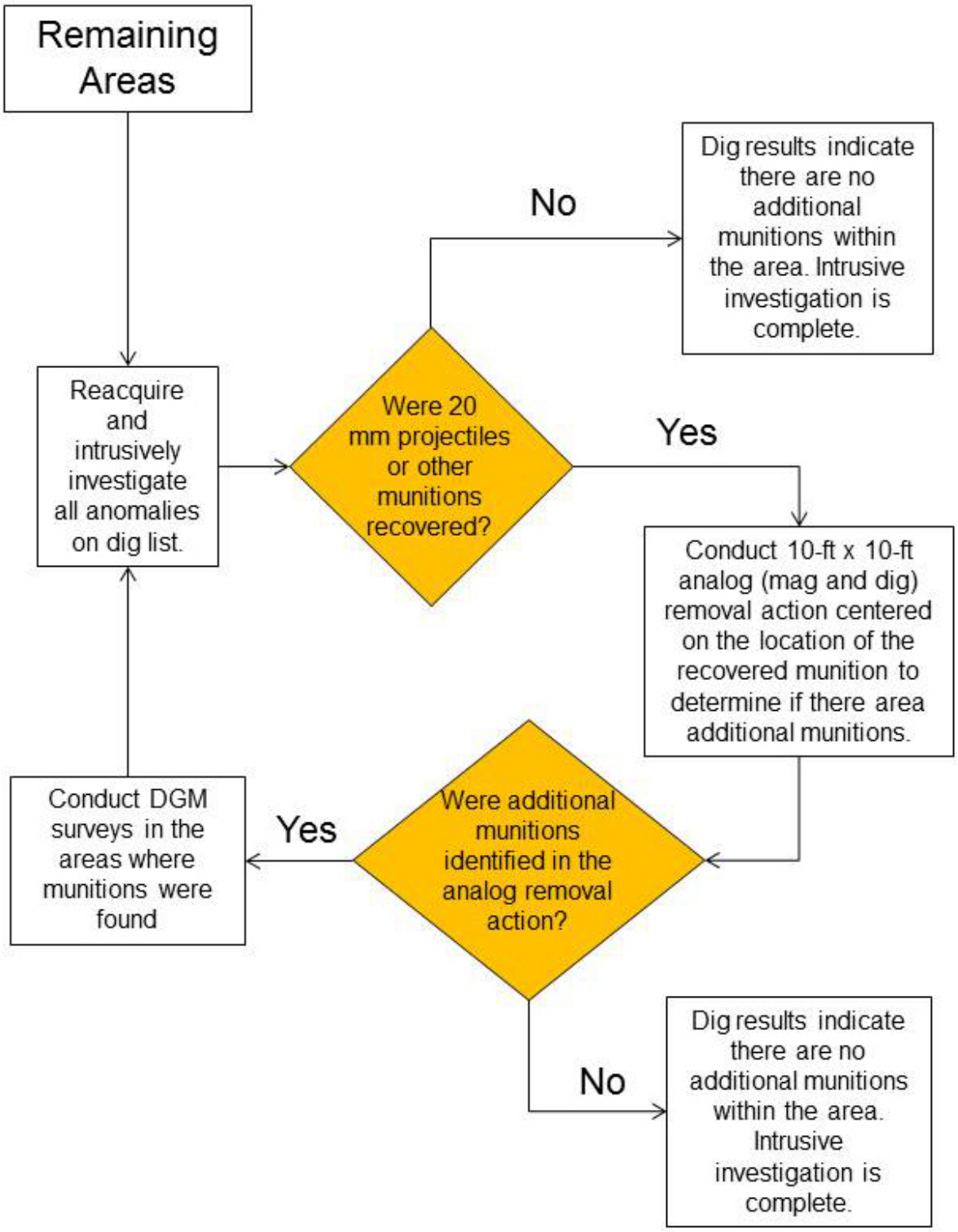


Table 5-2: SWMU 10 Anomaly Selection

Grid	Number of Anomalies Above Detection Threshold (5 mV)	Anomalies Above Anomaly Selection Threshold (7 mV)				Anomalies between Detection (5 mV) and Anomaly Selection (7 mV) Thresholds		Total Number of Anomalies for Intrusive Investigation
		Number of Anomalies	Number of Anomalies with Normal Decay for Intrusive Investigation[1]	Number of Anomalies with Non-Normal Decay	Number of 25% QC Anomalies with Non-Normal Decay[1]	Number of Anomalies	Number of 10% QC Anomalies between 5 and 7 mV[1,2]	
A01	98	89	88	1	1	9	1	90
A02	53	41	40	1	0	12	0	40
A03	56	45	45	0	0	11	1	46
A04	40	24	24	0	0	16	3	27
A05	52	45	27	18	3	7	0	30
A06	63	55	25	30	11	8	1	37
A07	3	1	1	0	0	2	0	1
B01	195	146	146	0	0	49	8	154
B02	200	147	147	0	0	53	6	153
B03	25	8	8	0	0	17	0	8
B04	43	10	9	1	0	33	4	13
B05	99	38	33	5	3	61	8	44
B06	148	109	61	48	11	39	5	77
B07	1	0	0	0	0	1	0	0
C01	218	143	142	1	1	75	6	149
C02	298	226	226	0	0	72	7	233
C03	101	84	84	0	0	17	2	86
C04	20	1	1	0	0	19	3	4
C05	123	38	25	13	1	85	11	37
C06	96	56	36	20	4	40	4	44
D01	153	63	49	14	3	90	12	64
D02	72	27	7	20	4	45	2	13
D03	163	119	109	10	5	44	5	119
D04	71	40	29	11	1	31	0	30
D05	42	12	10	2	1	30	1	12
D06	9	3	3	0	0	6	2	5
E01	130	61	61	0	0	69	7	68
E02	55	13	13	0	0	42	6	19

Grid	Number of Anomalies Above Detection Threshold (5 mV)	Anomalies Above Anomaly Selection Threshold (7 mV)				Anomalies between Detection (5 mV) and Anomaly Selection (7 mV) Thresholds		Total Number of Anomalies for Intrusive Investigation
E03	52	13	13	0	0	39	8	21
E04	57	39	39	0	0	18	0	39
E05	78	25	24	1	0	53	5	29
E06	4	1	1	0	0	3	1	2
F01	302	176	176	0	0	126	11	187
F02	180	35	35	0	0	145	13	48
F03	216	64	64	0	0	152	16	80
F04	154	47	47	0	0	107	6	53
F05	222	117	115	2	0	105	7	122
F06	11	7	7	0	0	4	1	8
G01	119	90	90	0	0	29	3	93
G02	82	49	49	0	0	33	3	52
G03	93	42	42	0	0	51	4	46
G04	96	53	51	2	0	43	8	59
G05	126	89	88	1	1	37	3	92
G06	17	9	9	0	0	8	0	9
Total	4436	2500	2299	201	50	1936	194	2543

[1] Columns that are included in the total number of intrusive investigation column.

[2] This column represents 10% of the anomalies detected between the 5mV and 7mV range.

Table 5-3: SWMU 10 Anomaly Resolution Sampling

Lot Number	Grid	Anomalies Selected for Investigation and Resolution		
		Number of Anomalies Selected for Investigation	Number of Anomalies in Lot	Number of Anomalies to Resolve Per Lot
1	A01	90	203	138
	A02	40		
	A03	46		
	A04	27		
2	A05	30	222	143
	A06	37		
	A07	1		
	B01	154		
3	B02	153	174	128
	B03	8		
	B04	13		
4	B05	44	270	155
	B06	77		
	B07	0		
	C01	149		
5	C02	233	233	146
6	C03	86	235	147
	C04	4		
	C05	37		
	C06	44		
	D01	64		
7	D02	13	179	130
	D03	119		
	D04	30		
	D05	12		
	D06	5		
8	E01	68	178	129
	E02	19		

	E03	21		
	E04	39		
	E05	29		
	E06	2		
9	F01	187	235	147
	F02	48		
10	F03	80	263	153
	F04	53		
	F05	122		
	F06	8		
11	G01	93	191	134
	G02	52		
	G03	46		
12	G04	59	160	122
	G05	92		
	G06	9		
Total:	Total:	2543	2543	1672

6.0 SWMU 40, BUILDINGS 12, 13 AND FORMER BUILDING 29 (INERT STORAGE WAREHOUSES)

6.1 BACKGROUND SWMU 40 ANOMALY AREA

SWMU 40 is located in the Southern Administration Area. There are 14 Permit-listed buildings and structures located in the SWMU consisting primarily of storage and warehouse type facilities.

The intent of this effort is to conduct an investigation based on statistical sampling of anomalies from the geophysical data collected during the RFI. A random sampling of anomalies in each building area will be intrusively investigated IAW the procedures outline in Section 4.

6.1.1 Location, Description, and Operational History

SWMU 40 is within the FWDA Southern Administration Area. Figure 6-1 shows the current SWMU 40 structures associated with the RCRA Permit. While this section of the work plan is limited to Buildings 12, 13 and the former Building 29 area, complete background information regarding FWDA and Parcel 11 is provided in numerous documents previously submitted to NMED including the following:

- Final - RCRA Facility Investigation Report, Parcel 11, Revision 2, volume 1, 2, 3 - FWDA (USACE, 2014);
- Summary Report of Historical Information, Parcel 11 – FWDA (TPMC, 2009)
- RCRA Facility Investigation Work Plan Final, Parcel 11, Revision (TPMC, 2009)

6.1.2 Conceptual Site Model

The CSM for SWMU 40 is presented in Table 6-1 below.

Table 6-1: SWMU 40 Statistical Sampling Area CSM

Profile Type	Site Characterization
Profile	Area and Layout ▪ SWMU 40 Statistical Sampling Area is approximately 3.5 acres in size and is located adjacent to Buildings 12, 13 and former building 29.
	Structures ▪ Structures located in the investigation area include Buildings 12, 13 and the location of former Building 29.

Profile Type	Site Characterization
	o Buildings 12 and 13 are single-story brick structures used as Inert Storage Warehouses, approximately 68 ft wide and 202 ft long. Both buildings have been used as food storage warehouses since 1972. o Former building 29 was an Inert Storage Warehouse approximately 60 ft wide and 500 ft long. Building 29 was originally the Ammunition, Linking, Belting and Clipping Building. The building was demolished in 1999. ▪ Railroad lines extend to the north of Buildings 12 and 13 and to the south of former Building 29 in the investigation area.
	Location ▪ SWMU 40 Statistical Sampling area is located in the Southern Administration Area, in the northwest portion of FWDA
	Utilities ▪ Limited utility lines are anticipated at the project site. Location of utility lines is unknown; therefore, a utility mark-out may be required prior to conducting any intrusive work at the site. Utility locates will be coordinated with FWDA Caretaker 10 days in advance.
	Security ▪ SWMU 40 is located within FWDA, a secure facility
Land Use and Exposure Profile	Current Land Use ▪ FWDA is in BRAC care taker status undergoing environmental investigation and remediation
	Potential Future Land Use ▪ After environmental remediation the land will be turned over to BIA and held in trust for the Navajo Nation and/or the Pueblo of Zuni.
	Human Receptors ▪ Receptors include facility caretaker personnel and those conducting environmental investigation and remediation
	Potential Future Human Receptors ▪ Receptors include BIA authorized land users
Ecological Profile	Degree of Disturbance ▪ FWDA provides habitat for moderate grasslands and sagebrush as well as antelope, prairie dogs, rattlesnakes, field mice, various insects and animals. Occasionally mountain lions, elk and bear are present. However, the site is highly disturbed based on past and current building use.
Munitions/ Release	Munitions

Profile Type	Site Characterization
Profile	▪ Munitions potentially present at SWMU 40 include 37mm and 75 mm projectiles.
	Munitions Debris ▪ MD originating from 37mm and 75 mm projectiles were identified near Building 12 during previous site work
	Associated Munitions Constituents ▪ No munition constituents were detected during the RFI.
	Transport Mechanisms / Migration Routes / Pathway Analysis ▪ Based on the information available to date for the SWMU 40 Statistical Sampling Area there is a potentially complete surface and subsurface exposure route for contact with MEC and/or munitions debris. There are no drinking water wells or identified munitions constituents in the area therefore no dermal, ingestion or inhalation exposure routes exist for groundwater.

6.1.3 Surface Conditions

SWMU 40 is typically characterized by a flat ground surface. The ground surface is generally gravel or soil covered. There are no defined storm water management structures. The MEC removal area is generally flat with limited vegetation coverage.

6.1.4 Subsurface Conditions

Geophysical data collected during previous investigation efforts have not indicated unusual geophysical conditions or an unusual quantity of ‘hot rocks’.

Based on the geophysical data collected, the investigation area may contain subsurface utilities. In addition, railroad lines are present in the investigation area.

6.2 PREVIOUS MEC INVESTIGATIONS

6.2.1 USGS EM61-MK2 DGM Survey

The geophysical investigation was performed using the EM61-MK2 in cart mode with a Leica RTK GPS 1200 rover unit mounted on a backpack frame. For this particular survey, the Leica RTK positional output was set to match the data acquisition rate of the EM61-MK2 which was 10 Hz.

Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 6-1

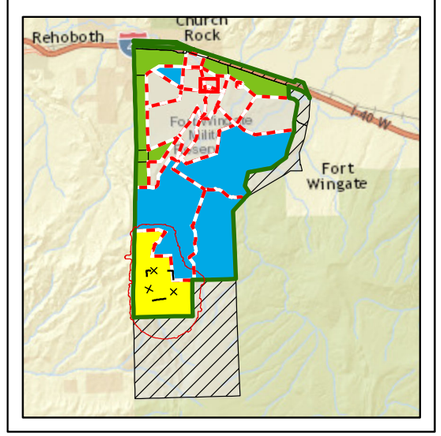
SWMU 40
Geophysical Survey Area

Legend

- SWMU & AOCs
- Parcel 11
- Approximate Extent of Geophysical Investigation
- Fence

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- 11 Parcel Number



N

0 100 200 400 Feet

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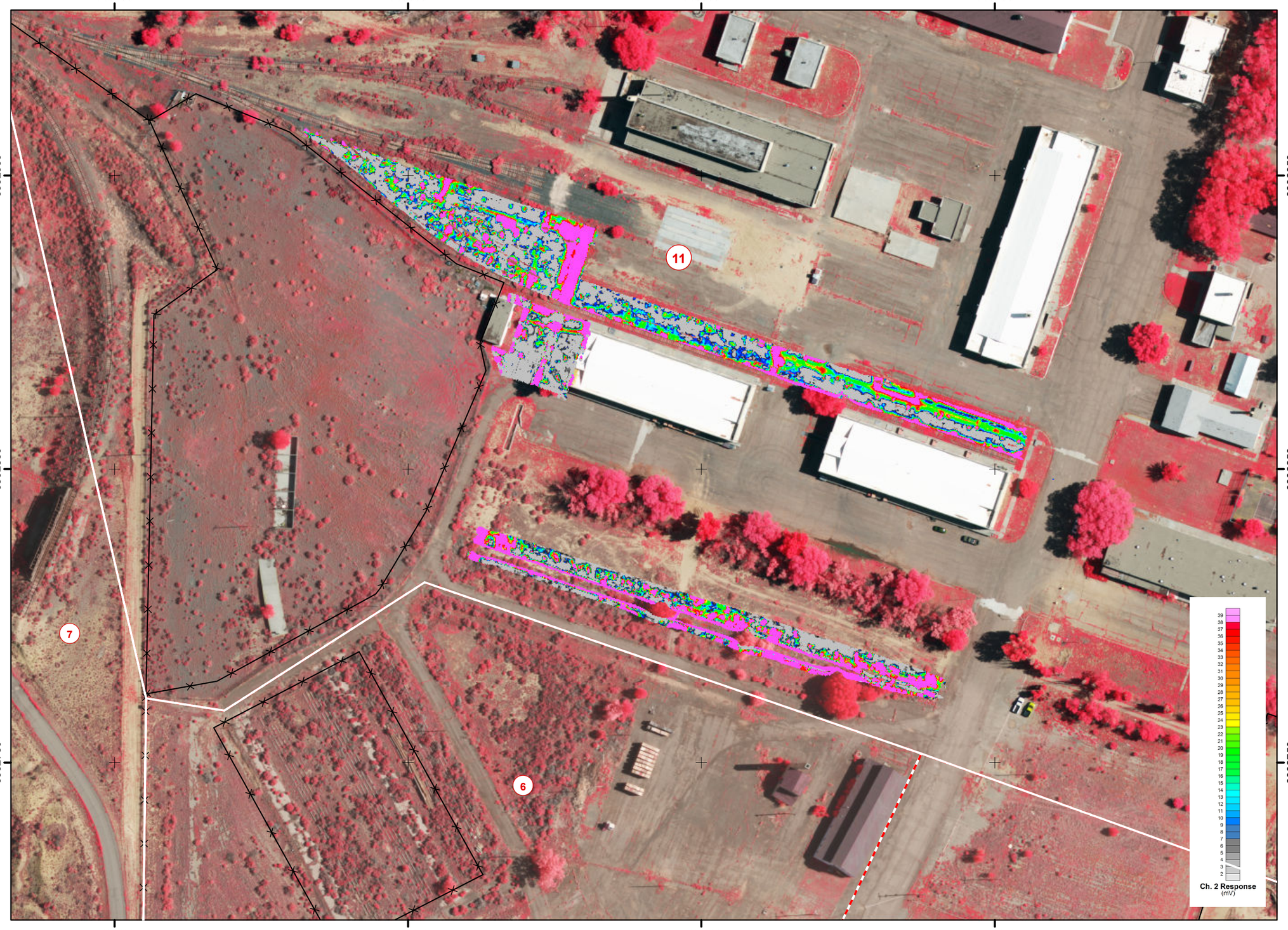
Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 6-2

SWMU 40 Geophysical Data
Buildings12, 13 and Former
Building 29



Legend

Fence

Parcel Status

Army Parcel Boundary

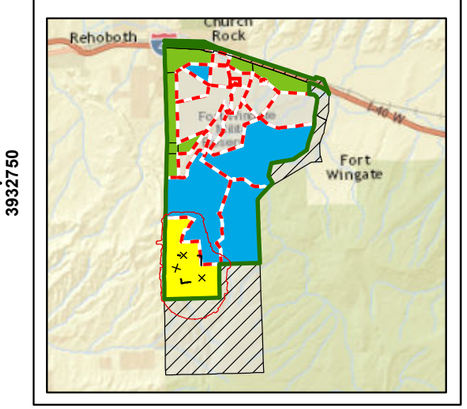
Army Retained

Army, Leased to MDA

Army, Pending Transfer

Removed from Permit

11 Parcel Number



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The investigation was performed in two areas near Buildings 12 and 13, i.e. Areas 2A and 2B and one area near former Building 29, i.e. Area 1. Figure 6-2 shows the results of the geophysical survey performed during 2009.

Statistical sampling of subsurface anomalies based on the results of the geophysical survey conducted during the RFI in this area is recommended.

6.3 INVESTIGATION METHODS

6.3.1 Location Surveys and Mapping Plan

Procedures that will be implemented for location surveys, site mapping and grid layout are specified above in Section 4.4.3. Two control monuments will be established at SWMU 40 to use as RTK DGPS base stations.

6.3.2 Anomaly Reacquisition and Resolution Procedures

Procedures for anomaly reacquisition and resolution at SWMU 40 are specified above in Section 4.4.8. The total number of anomalies is shown in Figure 6-3 and the anomalies selected for removal are shown in Figure 6-4.

6.3.3 Geophysical QC Procedures

Procedures for geophysical QC are specified in Appendix G.

6.3.4 Intrusive Investigation

Procedures to be implemented during the execution of the intrusive investigation are specified above in Section 4.4.10.

6.4 SCOPE OF ACTIVITIES

A statistical sampling of the anomalies meeting the anomaly selection criteria will be reacquired and intrusively investigated to determine whether MEC is present within SWMU 40. Anomalies with EM61-MK2 responses greater than 7 mV on channel 2 were selected, but removed high response anomalies adjacent to buildings that are not due to MEC, but are likely due to features such as building footprints and underground pipes. The 7 mV threshold was used because noise levels in the DGM data appear to be similar to those found in the SWMU 10 dataset. A total of 748 anomalies were detected above the 7 mV anomaly selection threshold. The Estimating a Proportion method with the finite population correction, as outlined in Appendix M, has been used to determine that 254 anomalies must be dug to determine the

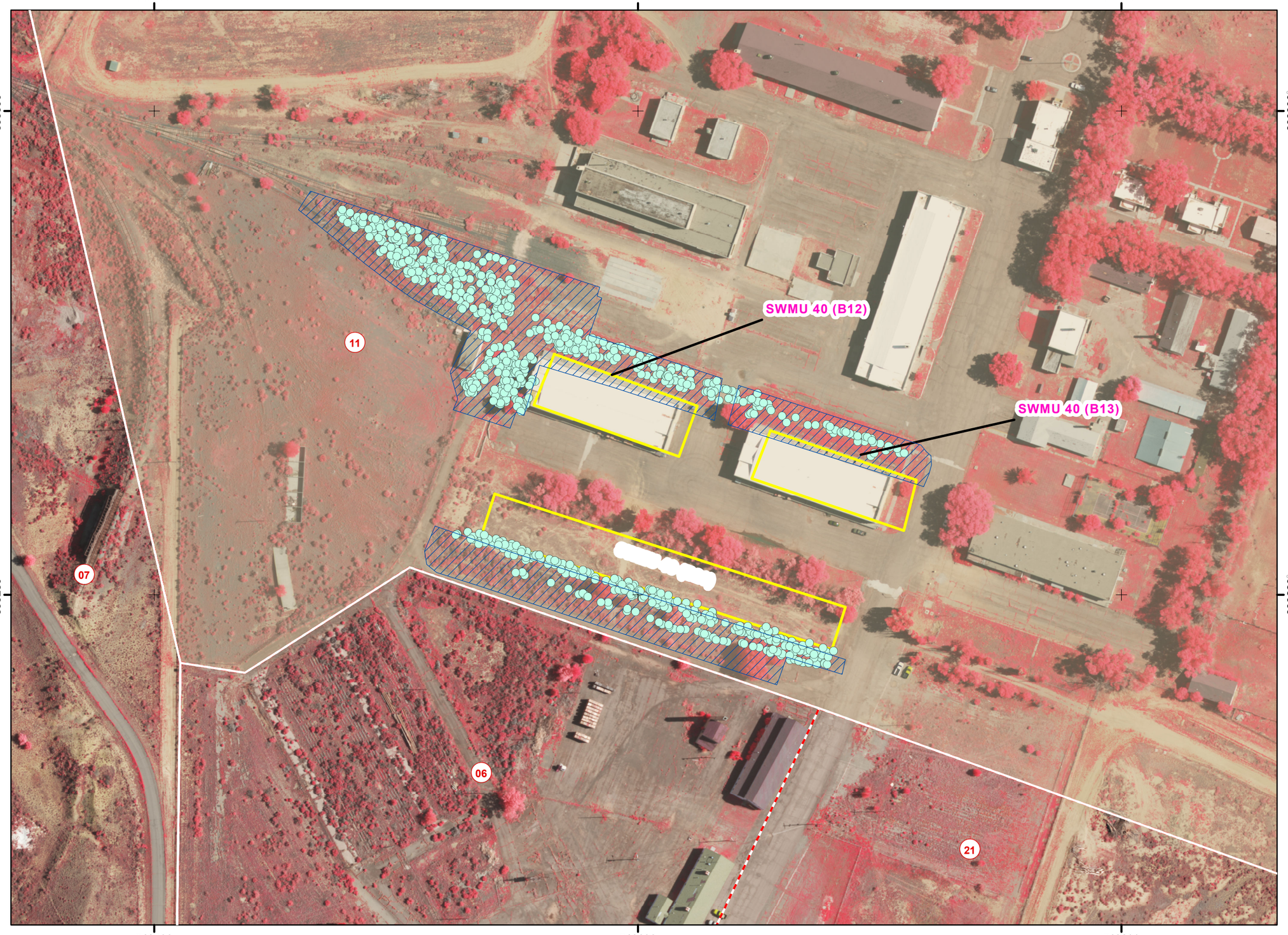
proportion of anomalies due to MEC with a 95% confidence level. All anomalies will be treated as one lot and 42 anomalies will be resolved to show to a 90% confidence level that 95% of the anomalies were resolved, which is the default value in IGD 14-01 (USACE, 2013) for remedial investigations where MEC has not been found.

Fort Wingate Depot Activity

McKinley County, New Mexico

Figure 6-3

SWMU 40 All Anomalies

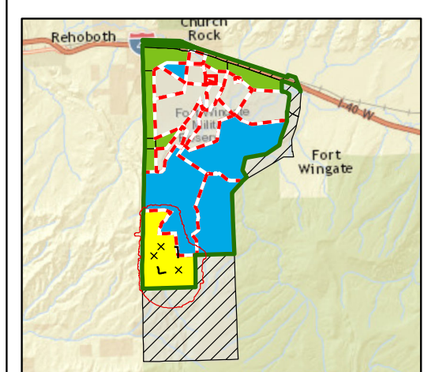


Legend

- SWMU/AOC
- Parcel 11
- Approximate Extent of Geophysical Investigation
- Anomaly

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- 11 Parcel Number



N

0 2.5 5 10 Miles

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McKinley County, New Mexico

Figure 6-4

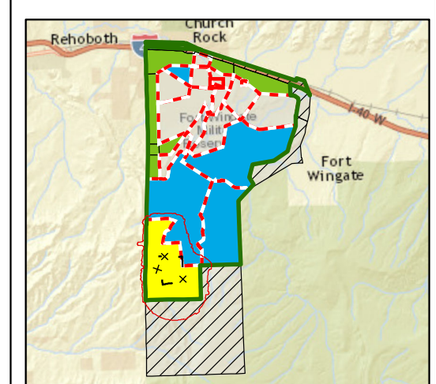
SWMU 40 Anomalies for Intrusive Investigation

Legend

- SWMU/AOC
- Parcel 11
- Approximate Extent of Geophysical Investigation
- Anomaly

Parcel Status

- Army Parcel Boundary
- Army Retained
- Army, Leased to MDA
- Army, Pending Transfer
- Removed from Permit
- 11 Parcel Number



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0 2.5 5 10 Miles

Drawn By: **OOT**	Date: **2/10/2015**	Job Code: **14-41-137**	MXD: \\arcadis-us.com\officedata\HoffmanEstates-IL\Project\ARMY\Fort_Wingate\MXDs\WP\Parcel_11
Datum: **WGS 84**	CS: **UTM 12N**		PDF: \\arcadis-us.com\officedata\HoffmanEstates-IL\Project\ARMY\Fort_Wingate\PDFs\WP\Parcel_11

PIKA ARCADIS MALCOLM PIRNIE A JOINT VENTURE

7.0 PROJECT MANAGEMENT

7.1 PROJECT SCHEDULING AND REPORTING REQUIREMENTS

The projected schedule for conducting activities at SWMU 10 and 40 is as follows:

Field Activities	Begin April 2016, assuming prior Tribal and NMED approval of Work Plan and weather permitting. Field work will take approximately 60 days.
Submittal of Army Draft Report	Planned submission November 2016
Submittal of Final Report to Tribes and NMED	Submitted 20 days after receipt and resolution of comments on the Army Draft Report
Submittal of Approved Final Report	Submitted 30 days after receipt and resolution of comments on report from tribes.

A full schedule for this project is provided as Appendix H of this Work Plan.

7.2 OTHER PROJECT PLANS

An Explosive Management Plan is provided as Appendix A. This document addresses procedures associated with the requisition, receipt, storage, transportation, inventory and use of demolition material at Parcel 11.

An APP/SSHP, describing the safety program to be implemented on the site, has been prepared for the field activities proposed in this Work Plan (Appendix D).

The project QC Plan for the MEC removal and intrusive investigation activities is included as Appendix G.

An EPP WMP has been prepared for the work covered in this Work Plan (Appendix I). The EPP includes the Waste Management Plan (WMP) identifies types of waste, methodology to characterize and dispose or recycle wastes, and track waste. The WMP is closely linked to the Hazardous Waste Contingency Plan which is also included in the EPP.

7.3 COMMUNITY RELATIONS PLAN

The installation-wide Community Relations Plan (TerranearPMC, 2006) will be adhered to during implementation of the RFI activities.

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APPENDIX A

EXPLOSIVE MANAGEMENT PLAN

EXPLOSIVES MANAGEMENT PLAN

INTRODUCTION

This plan addresses procedures associated with the requisition, receipt, storage, transportation, inventory and use of demolition materials at the Kickout Area and Parcels 11, 20, and 22. This plan incorporates local, state and Federal laws and regulations to include Bureau of Alcohol, Tobacco, Firearms and Explosives (BATFE) Pamphlet (PAM) ATF P5400-7, which is an excerpt from 27 CFR Part 55; DoD 6055.09-M, Department of Transportation (DOT) Regulations, DA regulations (AR) 190-11 and the JV policies and procedures. A copy of the JV BATFE license will be available on-site.

Procedures to be followed during use of explosives, removed MEC and related material in support of removal actions and demolition activities are detailed in this plan. The measures are applicable to all the JV employees, clients and visitors entering a MEC contaminated work site where explosives, MEC or related material and demolition materials are being stored on-site.

During explosive operations, safety is the primary concern. The most obvious requirements are to protect personnel, the general public and the environment from fire, blast, noise, fragmentation and toxic releases. Proper inspection, handling, packaging and inventory controls are all tasks that must be considered to conduct a safe and efficient operation.

All transactions relating to explosive material acquisition and expenditures of explosive materials will be maintained for a period of five (5) years. Records will be maintained at the project office during on-site and subsequently moved to the business unit of the BATFE license holder.

LICENSES/PERMITS

The procedures detailed in this plan have been developed to assure that a safe and efficient MEC and demolition material operation are conducted. Each individual authorized to receive; issue, transport and use explosives will be identified by name and will assume accountability when signing receipt or transfer documents. At each project site, any licenses or permits required to purchase, use, transport or store explosives will be on posted and made available to federal, state or local agencies upon request.

Explosives are purchased under a “User of High Explosives License” issued by the BATFE. The license holder must provide written authorization designating the individuals authorized to purchase, store or use explosives. A copy of the letter will be maintained in the project office and will reflect:

Name of Individual;

Home Address;
Date of Place of Birth; and
Social Security Number.

ACQUISITION

The JV only acquires explosives from licensed explosive manufacturers who provide the best value to the government. Jet perforators and/or boosters, both with detonation cord used along with electric detonators, are used for demolition shots to control the operation and reduce the NEW to be used (when, and if, needed). The JV uses DOT Class 1.4 explosives whenever possible, which are safer to handle, easier and less expensive to ship, store and more readily available for use. A generalized demolition materials list anticipated for use at the KOA are presented in Table 5-1.

Table 5-1: Demolition Material Anticipated for Use at Fort Wingate KOA

Description	Estimated Quantity	DOT Hazard Class and Division	Total NEW	UN Number
Boosters (1 pound [lb])	500 each	1.1D	500 lbs	UN 0042
Boosters (0.5 lb)	500 each	1.1D	250 lbs	UN 0042
Perforators (19-22 gram)	1000 each	1.4S	50 lbs	UN 0441
Det Cord (80-100 grain)	10000 feet	1.4D	143 lbs	UN 0065
Electric Squibs	200 each	1.4S	0.64 lbs	UN 0454
Smokeless Powder	85 lbs	1.3C	85 lbs	UN 0161
Safety/Time Fuse	2000 feet	1.4S	13.6 lbs	UN 0105
Fuse Lighters	200 each	1.4S	0.02 lbs	UN 0131
Blasting Caps, Electric	1500 each	1.4B	3 lbs	UN 0255

The SUXOS will be responsible for initiating requisitions for demolition materials. This will be accomplished by submitting a purchase order request through the JV PM who reviews and approves the request before forwarding it to accounting. Procurement of explosive materials will

be limited to the amount needed to complete the operations outlined in specific task orders. The requisition of explosives will be IAW the JV purchasing policy to ensure the best possible price for acquiring the explosive materials.

The JV will purchase the required explosives from WESCO a licensed vendor utilizing the competitive bidding process. The distributor will provide a certified statement of the intended use of the explosive material. This source will be licensed by the BATFE and the state to sell and transport initiators/high explosives and will be capable of re-supply within a 24-hour period.

INITIAL RECEIPT AND ISSUING PROCEDURES

Initial receipt of demolition explosives and materials will be conducted IAW the JV Explosives Acquisition, Storage and Accountability SOP, which is provided in the APP.

Responsibilities

SUXOS

The SUXOS maintains overall responsibility to process and requisition for the required demolition materials. The SUXOS is also ultimately responsible for maintaining accountability of demolition materials and immediately reporting any losses or discrepancies to the BATFE, CESWT/CESWF PM/KO, FWDA POC and the JV PM. The SUXOS will also ensure that all deliveries are coordinated with FWDA and local law enforcement agencies and that all explosives ordered for operations are consumed of properly.

Individual Personnel

All the JV employees are responsible for ensuring the proper and safe handling, use and control of demolition explosives/materials. In addition, these personnel are responsible for the proper consummation of explosives/materials.

Authorized Personnel

Only the JV SUXOS, UXOSO, and UXOQCS will be permitted to receive and issue explosives.

EXPLOSIVE STORAGE MAGAZINE

The JV will store project explosives in DDESB sited BATFE Type I Earth Covered Magazines (ECM). The ECMs operate under a Conditional Exemption (CE) IAW DoD 6055.09-M-V7. The ECMs have been previously sited and DDESB approved for CE storage per DDESB Approval Memorandum, DDESB-PE, 30 May 2008, Subject: DDESB approval of request for a Time Critical Removal Action (TCRA), Explosives Safety Submission (ESS) for Fort Wingate Depot Activity (FWDA), McKinley County, New Mexico, and will require no change to the previously approved limits.

A total of eight (8) ECMs in Explosive Storage Area B (Map B-4 in Appendix B), have each been sited for a storage limit of 20,000 lbs NEW for Hazard Division (HD) 1.1, and have been designated for CE Storage of recovered MEC and demolition/donor explosives. All of the qualifying conditions of the CE, which include the type of munitions that can be stored, how the munitions are stored, the notification requirements, as well as stringent recordkeeping and documentation requirements, will be met IAW the ECM SOP.

All stored explosives will be compatible IAW DoD 6055.09-M, BATFE Publication 5400.7 and DA Pamphlet (PAM) 385-64. All magazines will be properly grounded, lightning protected, set-up and secured IAW National Fire Protection Agency (NFPA) 780, USACE EM 385-1-97 and DA PAM 385-64. The ECMs are located inside a secure perimeter fence with approved access only. Donor explosives will be assigned a DoD hazard classification and storage compatibility group.

TRANSPORTATION

Procedures for Transporting Explosives

Transportation of explosives will be conducted IAW the JV Explosives Transport SOP-203, which is provided in the APP. The roads to be traveled are located within FWDA boundaries and will include both paved and unpaved roads. The JV personnel transporting explosives will use two BATFE-approved day boxes for the transport of demolition materials. The first box will contain the detonators, and the second box will contain the perforators, boosters, detonation cord, or powders. A predetermined route will be identified and used when transporting explosives.

Requirements for Explosives Transport Vehicle

The vehicles used by the JV to transport explosives will be inspected prior to use each day using the JV vehicle checklist. DD Form 626 will be completed. The requirements for the vehicle used to transport explosives include the items listed below:

- Vehicle engine will not be running and wheel chocks will be set when loading/unloading explosives and materials.
- Explosives will be transported in a covered pick-up truck whenever possible. When using an open vehicle, explosives will be covered with a flame resistant tarpaulin (except when loading/unloading).
- The area of the vehicle where the explosives are placed for transportation will have a plastic bed liner, dunnage or sandbags placed in the area to protect the explosives from contact with the metal bed and fittings.
- Explosives transport vehicles will have placards, a first aid kit, two (2) 10-lbs ABC fire extinguishers and communications capabilities.

- Compatibility requirements will be observed.
- Drivers will comply with posted speed limits, but will not exceed a safe and reasonable speed for conditions at hand.

INVENTORY

The JV Explosives Acquisition, Storage and Accountability SOP-206 lists the procedures to be followed for the inventory, notification of loss/theft, return of unused materials/storage of unused materials at the end of each day and the disposition of demolition material/explosives at the conclusion of the project.

Reconciliation of Discrepancies

In the event there is a discrepancy during the inventory, the item(s) will be recounted a minimum of two (2) additional times. If a discrepancy still exists, the JV PM, FWDA POC, CESWT/CESWF PM/KO and BATFE will be notified.

Lost, Stolen or Unauthorized Use

If it is discovered that explosive items have been lost, stolen or used without proper authorization, the JV PM, FWDA POC, CESWT/CESWF PM/KO and BATFE will be notified.

Return of Explosives to Storage

Following each occurrence of a receipt or issue of explosives/materials, the SUXOS will conduct a joint inventory in conjunction with the UXOSO or UXOQCS of the effected explosives materials. Only those items issued/returned will be inventoried.

Forms

All forms associated with the receipt, storage, inventory and use of demolition explosives/materials will be kept onsite with the SUXOS and/or UXOSO.

APPENDIX B
STANDARD OPERATING PROCEDURES

JV SOP-203: Transportation of Explosives
JV SOP-204: MEC Quality Control
JV SOP-205: Inspection, Disposal and Chain of Custody
JV SOP-206: Explosives Acquisition, Shipping and Accountability
JV SOP-207: MEC Disposal
JV SOP-515: Safe Vehicle Operation
JV SOP-516: Vegetation Removal
JV SOP-601: Surface Clearance
JV SOP-602: Anomaly Avoidance
JV SOP-603: DGM Data Collection
JV SOP-604: DGM Data Processing
JV SOP-605: DGM Target Reacquisition
JV SOP-607: Intrusive Investigations

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the procedures applicable to the transport of explosives to include demolition material and munitions and explosives of concern (MEC).

2.0 EXPLOSIVES AND MEC TRANSPORTATION REQUIREMENTS

2.1 GENERAL REQUIREMENTS

Contractors transporting MEC or explosives will comply with Federal, state, and local regulations. Permits for the transportation of explosives or MEC are not required for on-site or inter-facility transportation within Federal installations. Off-site shipment of MEC and explosives will be accomplished by approved commercial carriers. For off-site shipment:

- MEC will be packaged in accordance with (IAW) 49 Code of Federal Regulations (CFR) part 172 and 173;
- Drivers will have Joint Venture (JV) Form-203A and 203B;
- Vehicles will be inspected using the JV Motor Vehicle Inspection Form 507 and/or DD626 as appropriate, and if applicable, be properly placarded;
- Compatibility requirements will be observed;
- The load shall be well braced, secured and, except when in closed vehicles, covered with a fire-resistant tarpaulin.
- Off-site transportation of unexploded ordnance (UXO) requires military explosive ordnance disposal (EOD) support to examine the ordnance, identify it, and confirm in writing that it is safe to transport. The term MEC, as used in this paragraph includes UXO.

2.2 TRANSPORTATION ON-SITE AND ON FEDERAL INSTALLATIONS

Transportation of explosives and MEC on-site and on Federal installations will comply with the following:

- Vehicles will be inspected prior to use each day using the JV Vehicle Inspection Checklists (JV Form-507 and/or DD 626 as appropriate and will be properly placarded;
- Vehicle engine will not be running, wheels will be chocked and brakes will be set when loading/unloading explosives;
- Explosives will be transported in closed vehicles whenever possible. When using an open vehicle, explosives will be covered with a flame resistant tarpaulin (except when loading/unloading);
- The area of the vehicle where the explosives are placed for transportation will have either a wood bed liner, dunnage, or sand bags placed in the area to protect the explosives from contact with the metal bed and fittings;
- Explosive vehicles will have a first aid kit, **a minimum of** two fire extinguishers with a rating of at least 2 A:10-B:C units, and communications capabilities;

- Initiating explosives, such as detonators, will remain separated;
- Compatibility requirements will be observed;
- Operators transporting explosives will have a valid driver's license;
- Operators will drive at a safe speed based on road conditions, but never over the speed limit. Vehicles transporting explosives off-road will not exceed 25 miles per hour (mph);
- The JV will also comply with any installation-specific explosives transportation procedures, to include those procedures related to drivers, equipment requirements and vehicle inspections.

2.3 GENERAL PLACARDING REQUIREMENTS

According to 49 CFR 172.504, the placarding requirements listed below will apply to JV explosives transportation:

(a) "Except as otherwise provided, each bulk packaging, freight container, unit load device, transport vehicle or rail car containing any quantity of a hazardous material must be placarded on each side and each end with the type of placards specified in Tables 1 and 2, in accordance with other requirements and exceptions." (Tables 1 and 2 are presented on the following page in Table 203-1 and 203-2.)

(c) Exceptions for less than 454 kilograms (kg) (1,001 pounds [lbs]). "Except for bulk packaging and hazardous materials subject to 49 CFR 172.505, when hazardous materials covered by Table 2 of this section are transported by highway or rail, placards are not required on:

(1) A transport vehicle or freight container which contains less than 454 kg (1,001 lbs) aggregate gross weight of hazardous materials covered by Table 2 of paragraph (e) of this section; or

(2) A rail car loaded with transport vehicles or freight containers, none of which is required to be placarded."

The exceptions provided in paragraph (c) provided above, do not prohibit the display of placards in the manner prescribed in this subpart, if not otherwise prohibited, on transport vehicles for freight containers that are not otherwise required to be placarded.

2.4 OFF-SITE TRANSPORTATION OF EXPLOSIVES OVER PUBLIC HIGHWAY

2.4.1 Department of Transportation (DOT) Certificate of Registration

DOT certificates of registration for JV persons involved in the transportation of demolition materials are not required as long as only 1.4 explosives or less than 55 lbs net explosive weight (NEW) of 1.1, 1.2, or 1.3 explosives are transported by JV personnel.

TABLE 203 – 1: PLACARDING REQUIREMENTS

Category of material (Hazard class or division number and additional description, as appropriate)	Placard name	Placard Design Reference
1.1	Explosives 1.1	172.523
1.2	Explosives 1.2	172.524
1.3	Explosives 1.3	172.525
2.3	Poison Gas	172.532
4.3	Dangerous When Wet	172.528
6.1 (PG I, inhalation hazard only)	Poison	172.542
7 (Radioactive Yellow III label only)	Radioactive	172.544

TABLE 203 – 2: PLACARDING REQUIREMENTS (CONTINUED)

Category of material (Hazard class or division number and additional description, as appropriate)	Placard name	Placard Design Section Ref.(□)
1.4	Explosives 1.4	172.523
1.5	Explosives 1.5	172.524
1.6	Explosives 1.6	172.525
2.1	Flammable Gas	172.532
2.2	Non-Flammable Gas	172.528
3	Flammable	172.542
Combustible liquid	Combustible	172.544
4.1	Flammable Solid	172.546
4.2	Spontaneously Combustible	172.547
5.1	Oxidizer	172.550
5.2 (Other than organic peroxide, Type B, liquid or solid, temperature controlled).	Organic peroxide	172.552
6.1 (PG I or II, other than Zone A or B inhalation hazard).	Poison	172.554
6.1 (PG III)	Keep Away from Food	172.553
6.2	(None)	
8	Corrosive	172.558
9	Class 9	172.560
ORM-D	(None)	

2.4.2 Definition of Commercial Motor Vehicles

The term “commercial motor vehicle” (CMV) means a motor vehicle, or combination thereof, used in commerce to transport passengers or property if the motor vehicle meets any of the following:

- It has a gross combination weight rating of 11,794 or more kg (26,001 lbs or more) inclusive with a towed unit with a gross vehicle weight rating of more than 4,536 kg (10,000 lbs); or
- It has a gross vehicle weight rating of 11,794 or more kg (26,001 lbs or more); or
- It is designed to transport 16 or more passengers, including the driver; or
- It is of any size and is used in the transportation of materials found to be hazardous for the purposes of the Hazardous Materials Transportation Act and

which require the motor vehicle to be placarded under the Hazardous Materials Regulations (49 CFR part 172, subpart E).

2.4.3 Commercial Drivers License (CDL) Requirements

As applicable, state specific CDL requirements will be complied with.

2.4.4 Mixed Packaging Requirements

Explosives of compatibility Group S may be packed with explosives of other explosive compatibility groups except A and L. To determine the compatibility of the materials typically transported by the JV, check the Material Data Sheets presented in Attachment 1 to this SOP.

3.0 DOCUMENTATION

3.1 JOINT VENTURE FORMS

Any time explosives are being transported this entire SOP to include the completed copies of supporting JV Forms-203A and 203B, will be in the vehicle. A brief description of the relevant forms is included below and shall be used for proper completion of the forms.

1. **JV FORM -203A**
   Only those items that are being transported will be entered in the form with the applicable qty/units and weight columns completed. It is imperative that the NEW limitations of 55 lbs. not be exceeded. Required data will be entered on the front and the Guide 50 block should be checked on the back of the form.
2. **JV FORM -203B**
   The form will be completed making sure the pertinent data for those transporting explosives is included on the form. As with the other required form, this one will also be part of the transport paperwork. Only the route shown will be used unless there is an emergency or the route is blocked. Any deviation from the planned route will be reported to and coordinated with the SUXOS.

3.2 BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS (BATF) PERMIT/LICENSE/EMPLOYEE POSSESSOR FORMS

A copy of the current BATF license/Employee Possessor Forms will accompany the vehicle and will be readily available for inspection. A copy of the BATF license/Employee Possessor Form will also remain at the project site whenever explosives transportation is being conducted.

4.0 REGULATORY REFERENCES

Procedures and information contained in this document were obtained from the below listed references:

- Department of Transportation, 49 CFR Parts 172, 173, and 383, and applicable sections.
- Occupational Safety and Health Administration (OSHA) 29 CFR 1910 General Industry Standards.
- OSHA 29 CFR 1926 Construction Standards.
- Department of Defense (DoD) 6055.9-M, DoD Ammunition and Explosive Safety Standards
- DoD 4145.26-M, DoD Contractor's Safety Manual for Ammunition and Explosives
- Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP) 16, Methodologies for Calculating Primary Fragment Characteristics
- DDESB TP 18, Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel
- DA-Pam 385-64, Ammunition and Explosives Safety Standards
- OSHA Construction Industry Standard 29 CFR Part 1926, Subparts O and P, Excavations
- U.S. Army Corps of Engineers (USACE) Engineering Regulation (ER) 385-1-92, Safety and Occupational Health Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) Activities
- USACE Engineering Manual (EM) 385-1-97, Explosive Safety and Health Requirements Manual
- USACE Engineering Pamphlet (EP) 1110-1-18, Ordnance and Explosives Response
- USACE EM 200-1-15, Technical Guidance for Military Munitions Response Actions
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-95, Safety and Health Requirements for Munitions and Explosives of Concern (MEC) Operations
- BATF Publication 5400-7 Federal Explosives Law and Regulations
- Technical Bulletin 700-2 Joint Technical Bulletin DEPARTMENT OF DEFENSE AMMUNITION AND EXPLOSIVES HAZARD CLASSIFICATION PROCEDURES
- The JV Corporate Environmental Safety and Health Plan (CESHP), Quality Management System (QMS) and SOP's (these documents will be on-site and available to site personnel during the project).

5.0 ATTACHMENTS

No attachments associated with this SOP.

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the on-site Unexploded Ordnance (UXO) Quality Control Specialist (UXOQCS) the minimum instruction necessary to ensure data quality meets the performance metrics contained within the final, approved work plan.

2.0 PROCEDURES

Quality Control (QC) procedures are broken down in this SOP into eight (8) sections. These sections are Surveillance Activities, Inspections, Data Quality, Non-Conformance/Non-Compliance, Corrective Actions, Root-Cause Analysis, Lessons Learned and Documentation. The UXOQCS and the Joint Venture (JV) Quality Control Manager (CQM) shall work together at the start of a specific project to develop any project-specific QC procedures and develop an activity/frequency index to make sure the more complex activities are surveilled more often than some of the more simple activities. The overall goal of the JV quality process is to move away from the costly procedure of controlling conformance through inspection. Instead, the JV will inspect work until such time as QC personnel are convinced that the level of quality is satisfactory then reduce the quantity of inspections while controlling quality through process surveillances. The amount of inspections will increase if a product is non-conforming or work is non-compliant with requirements and corrective actions initiated. Once corrective actions have been verified and the CQM concurs, inspections may be reduced.

2.1 SURVEILLANCE ACTIVITIES (PROCESS VERIFICATION)

Surveillance activities conducted at the project site will make sure actual work processes match those instructions set forth in the approved Work Plan (WP), work instructions and industry standards. It is the responsibility of the UXO Technician III (UXOTIII) and Senior UXO Supervisor (SUXOS) to make sure the written procedures are followed by personnel given such responsibility. It is then the responsibility of the UXOQCS to verify that these processes are being followed. Surveillances shall be documented in accordance with (IAW) Section 2.8 of this SOP. The UXOQCS will review the written processes for the activity being surveilled prior to conducting the surveillance. The UXOQCS will then travel to the location of the process being performed and examine the methods being conducted utilizing the written process as a reference and that actions are consistent with the procedures. Operational functions to be surveilled include, but are not limited to: tailgate safety briefing, equipment maintenance, equipment calibration, safety operations, grid tracking and control, safe separation distances, information gathering and reporting, clearance operations, geophysical operations, explosive storage and accountability, demolition procedures

and safety, scrap inspection, processing and disposal. If the actual work practices differ from the procedures detailed in the Scope of Work (SOW) or WP, a non-compliance exists and shall be documented IAW section 2.8 of this SOP.

2.2 INSPECTIONS

2.2.1 MIL-STD-1916 BASED INSPECTIONS (Process Validation)

MIL-STD-1916 was selected by the JV as its quality acceptance model for two reasons. First, MIL-STD-1916 is approved for use by Departments and Agencies of the Department of Defense for making sure of the quality of products and services. Secondly, it is a tool to be used in order to move away from the Acceptable Quality Level (AQL) methodology toward a Process Control system for quality. Once an acceptable level of quality has been established by operational functions and verified by the UXOQCS through the use of sampling inspection, a system of Process Control takes over and less sampling is required. This is accomplished with structured and documented process surveillances and a sampling inspection that is documented, repeatable and defensible.

To validate the work procedures being used to perform various tasks for a given project, the UXOQCS will conduct a sampling inspection of each area or item requiring customer acceptance. The most common types of inspections are listed below. In order to determine the type of sampling plan to implement, four items must be considered (See MIL-STD-1916 Section 4.2.3).

- Verification Level: Either the customer or the JV will assign a verification level to the project. This verification level (VL) varies depending on the size or quantity of items being inspected and the amount of effort needed for conformance. For most grid clearance type projects where grids are 100 feet square to 400 feet square, a VL of II is sufficient. For munitions debris (MD)/Range Related Debris (RRD) processing, the VL may need to be raised to accommodate a large amount of scrap being inspected.
- Type of Sampling: The type of sampling best suited to most UXO projects is attribute sampling.
- Lot or Interval Size Code Letter: This code letter (CL) is found by consulting MIL-STD-1916 Chapter 5 Table II and cross-referencing the lot size (for example: Grid lane quantity or pieces of MD/RRD scrap) with the VL.
- Sampling/Switching Procedure: After determining a sampling procedure (Reduced, Normal or Tightened) and consulting MIL-STD-1916 Chapter 5.2.1.3, the UXOQCS and CQM will determine the sampling size in this manner: Assuming a starting procedure of Normal (Most projects can be started at Normal sampling), inspections occur at a rate dictated by consulting MIL-STD-1916 Chapter 5 Table II and cross referencing the CL determined earlier in Table I with

the VL determined at the start of the project and determining the number directly under the VL (For example: A CL "A", a VL of II and a sampling of Normal would dictate a sampling size of 12.) The sample size can increase or decrease depending on the lot acceptance or rejection. Starting at Normal, if two lots in the past five inspected are rejected, the switching procedure dictates a switch to Tightened sampling. The size of the sample is found by consulting MIL-STD-1916 Chapter 5 Table II, and reading the number to the left of the Normal sample. In the case of the above example, the sample size would increase from 12 to 32. Tightened sampling will remain in effect until five consecutive lots have been accepted at which point Normal sampling will be resumed. Once 10 consecutive lots have been accepted, reduced sampling can be instituted. The number is again found by consulting MIL-STD-1916 Chapter 5 Table II, and reading the number to the right of the Normal sample. In the case of the above example the sample will be reduced to five. Reduced sampling will remain in effect until one lot is rejected at which point Normal sampling will be instituted.

As most removal actions are conducted in areas that have been delineated into quadrilateral grids, this SOP will assume this unless otherwise stated. These grids vary in size but are usually 100' x 100' or 200' x 200'. For QC purposes, grids are further delineated into lanes of varying widths. Generally, Mag and Dig grids are delineated into five-feet-wide lanes while grids cleared utilizing Digital Geophysics are delineated into two, two and a half or three feet lanes. Depending on the size of the grid, the number of lanes will vary. Inspection activities will be documented IAW section 2.8 of this SOP.

2.2.1.1 Inspection of Geophysical Cleared Grids

After a “lot” of DGM grid or transect data has been intrusively investigated and the source of the anomaly removed, the UXOQCS, or his designee will perform post-dig verification sampling to ensure that the anomaly source has been removed in accordance with the final, approved project work plan, DID WERS-004.01 and Interim Guidance Document (IGD) 14-01. Post-dig anomaly resolution sampling is conducted after intrusive investigations to verify that the source of the anomaly has been removed during the intrusive investigation. Anomaly resolution sampling should be completed after the intrusive investigation within a lot has been completed. The original geophysical instrument used to identify anomalies, or one that performs better than it, should be used to verify that the anomalies have been resolved.

The amount of post-dig anomaly resolution sampling within each lot will be determined based on the number of anomalies within the lot of data and the confidence levels required by the project’s performance requirements, which are specified within the

project work plan. Table 204-1 reproduces Table 6-6 within IGD 14-01 and will be used to determine the number of anomalies to be resolved within each lot.

The anomaly resolution process will ensure the anomaly peak is removed to below the anomaly selection threshold for the entire anomaly footprint to avoid leaving behind potential munitions. The instrument used for the DGM survey will be used to verify that the anomalies have been resolved. Anomaly resolution sampling will occur after intrusive work within each lot (e.g., one day of intrusive investigation, 1 acre, 1 days of DGM data collection) of data has been completed.

Within each lot, the Senior Geophysicist, or his designee, will select anomalies at random for verification in the field. Anomalies will fail the anomaly resolution process if the peak of the anomaly is still above the anomaly selection threshold and there is not a documented rationale for the remaining response (e.g., underground metallic pipe). If one of the anomalies selected for anomaly resolution within a lot fails, then the entire lot of data preliminarily fails. This will prompt a corrective action response to identify the source of the failure. If the source of the failure can't be explained, then the lot of data will fail and additional anomaly resolution sampling will be required.

Table 6-6: Acceptance Sampling for Anomaly Resolution

Confidence Levels	Lot Size (number of anomalies)							
	50	100	200	500	1000	2000	5000	10,000
70% Confidence < 10% unresolved[a]	11	11	12	12	12	12	12	12
80% Confidence < 10% unresolved	14	15	15	16	16	16	16	16
90% Confidence < 10% unresolved	18	20	21	22	22	22	22	22
95% Confidence < 10% unresolved	22	25	27	28	29	29	29	29
70% Confidence < 5% unresolved	17	21	23	23	24	24	24	24
80% Confidence < 5% unresolved	21	27	30	31	31	32	32	32
85% Confidence < 5% unresolved	23	31	34	36	37	37	37	37
90% Confidence < 5% unresolved[b]	27	37	41	43	44	45	45	45
95% Confidence < 15% unresolved	31	45	51	56	57	58	59	59
80% Confidence < 1% unresolved	40	80	111	138	144	154	158	159
85% Confidence < 1% unresolved	43	85	123	158	172	181	186	187
90% Confidence < 1% unresolved[c]	45	90	137	184	205	217	224	227
95% Confidence < 1% unresolved	48	95	155	225	258	277	290	294

Note: Values within the table show the number of anomaly locations chosen for intrusive investigation that require post-dig anomaly verification. All anomalies within the lot must be shown to be resolved to meet confidence levels (accept on zero).

a Default for RIs where UXO or DMM have been recovered

b Default for RIs where no UXO or DMM have been recovered

c Default for RA

These default values have been used in the past; however, they may not be appropriate for all sites and land uses. The PDT must choose the confidence levels and % unresolved values that meet the project objectives.

2.2.1.2 Inspection of Mag/Dig Cleared Grids

After operational clearance activities are completed and the grid has been offered to QC personnel for inspection and acceptance, the UXOQCS will determine the number of lanes available for that grid (i.e. A 100 feet wide grid will have 20, five feet wide lanes). Starting at the southwest corner, the UXOQCS will number the lanes from zero to twenty. Using a computer based (Microsoft Excel) random number generator the UXOQCS will generate a number of lanes equaling the percentage of area needing inspection. In other words, to inspect 15 percent of a 100 feet by 100 feet grid (10,000 sq. ft) the random number generator will be used to select 3 lanes for inspection (1,500 sq. ft) (see Figure 204-2) from the total number of lanes available. The UXOQCS will then proceed to the grid to be inspected and either mag and dig those selected lanes or collect digital geophysical data over those selected lanes. If a precision locating system was used during the operational clearance, it will also be used for QC purposes.

The instrument to be used during this inspection is dependent on the procedures specified in the WP and SOW. It is possible to use digital geophysical data collection, processing, reacquisition and investigation for QC inspection instead of mag and dig. If this is the case, a like technology instrument will be used as long as the WP and SOW are satisfied (i.e. if a Schonstedt Magnetometer is used during the clearance action, a Cesium Vapor Magnetometer would be a good candidate to collect digital geophysical data and if a White's All Metals Detector is used during the clearance action, an EM-61 would be a good candidate to collect digital geophysical data). If a digital geophysical data collection instrument is used for QC inspection, the collected data will be processed in the same manner as the operational data except that the CQM will nominate anomalies for investigation. If a like instrument (i.e. Schonstedt or White's) is to be used for QC, the results will be annotated on the QC Inspection Report with the following information: QC personnel, grid/area identification, random lanes selected, items found with x and y locations in the appropriate coordinate system as specified in the WP and SOW, disposition of items found. If failure criteria items are found, non-conformance/corrective action procedures will be initiated IAW section 2.4 of this SOP.

2.2.1.3 Inspection of MD/RRD

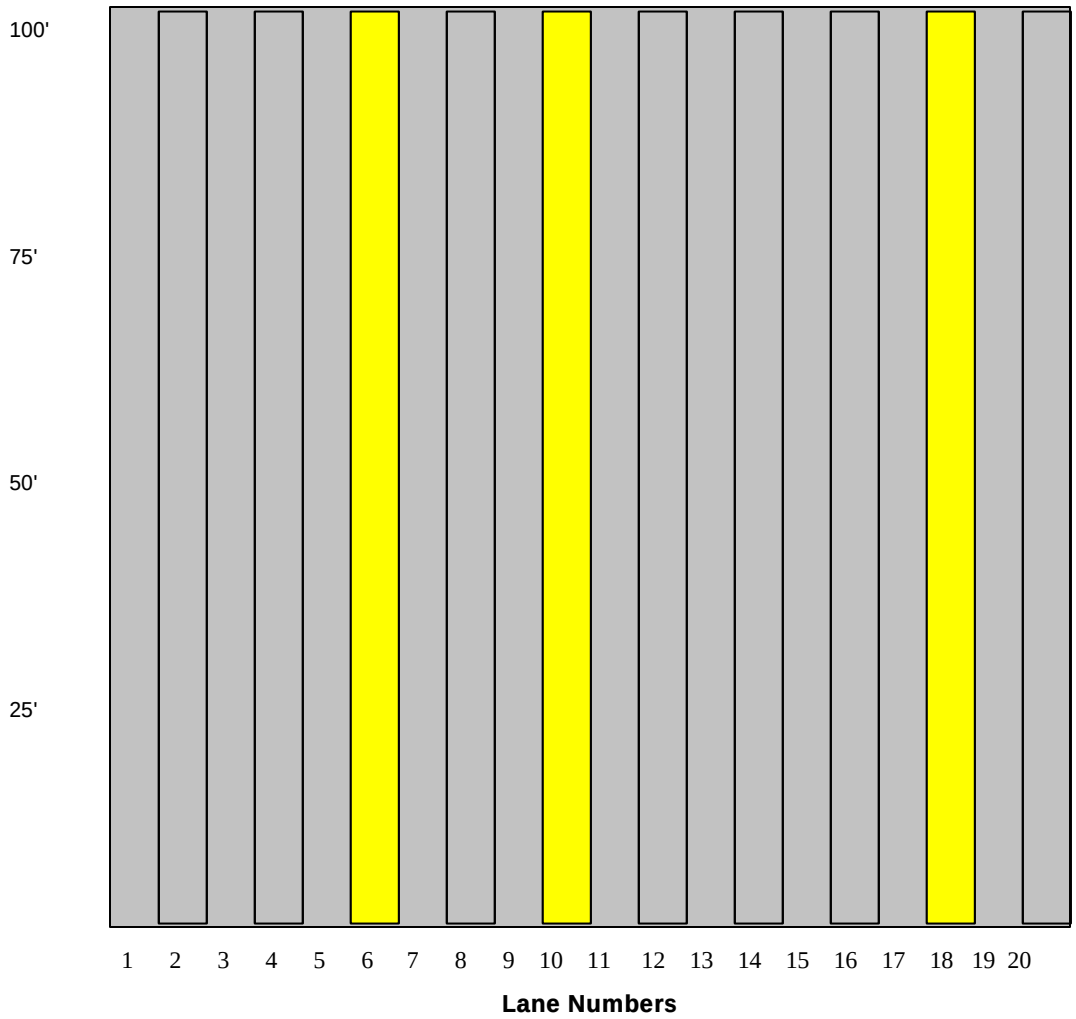
Refer to JV SOP-205 Inspection, Disposal and Chain of Custody for applicable procedures.

2.2.2 NON MIL-STD-1916 QC INSPECTION

When MIL-STD 1916 based inspections are undesirable, conventional inspections will be carried out IAW this SOP, the SOW and WP. These inspections will validate the JV's

work procedures by sampling worked product to determine its level of compliance to predetermined criteria. The UXOQCS will inspect a minimum of 10 percent random sample of a grid scrap. These inspections will consist of QC personnel performing a random sampling inspection. For cleared grids, the UXOQCS will travel to the grid being inspected and using the same type of instrument (for Surface/sub-surface clearances), randomly inspect at least 10 percent of the grid making sure to cover the grid from bottom to top and side to side. Starting at the southwest corner and traveling a zigzag pattern from south to north and west to east can usually accomplish a sufficient coverage (See Figure 204-3 for an example search pattern). If the quality of clearance is in question, the UXOQCS can increase the coverage area in order to assure compliance. For MEC scrap inspections, the UXOQCS will inspect a minimum of 10 percent of items IAW SOP-205 Inspection, Disposal and Chain of Custody.

Figure 204-2
Example of 100' x 100' grid divided into 20 five-feet lanes.

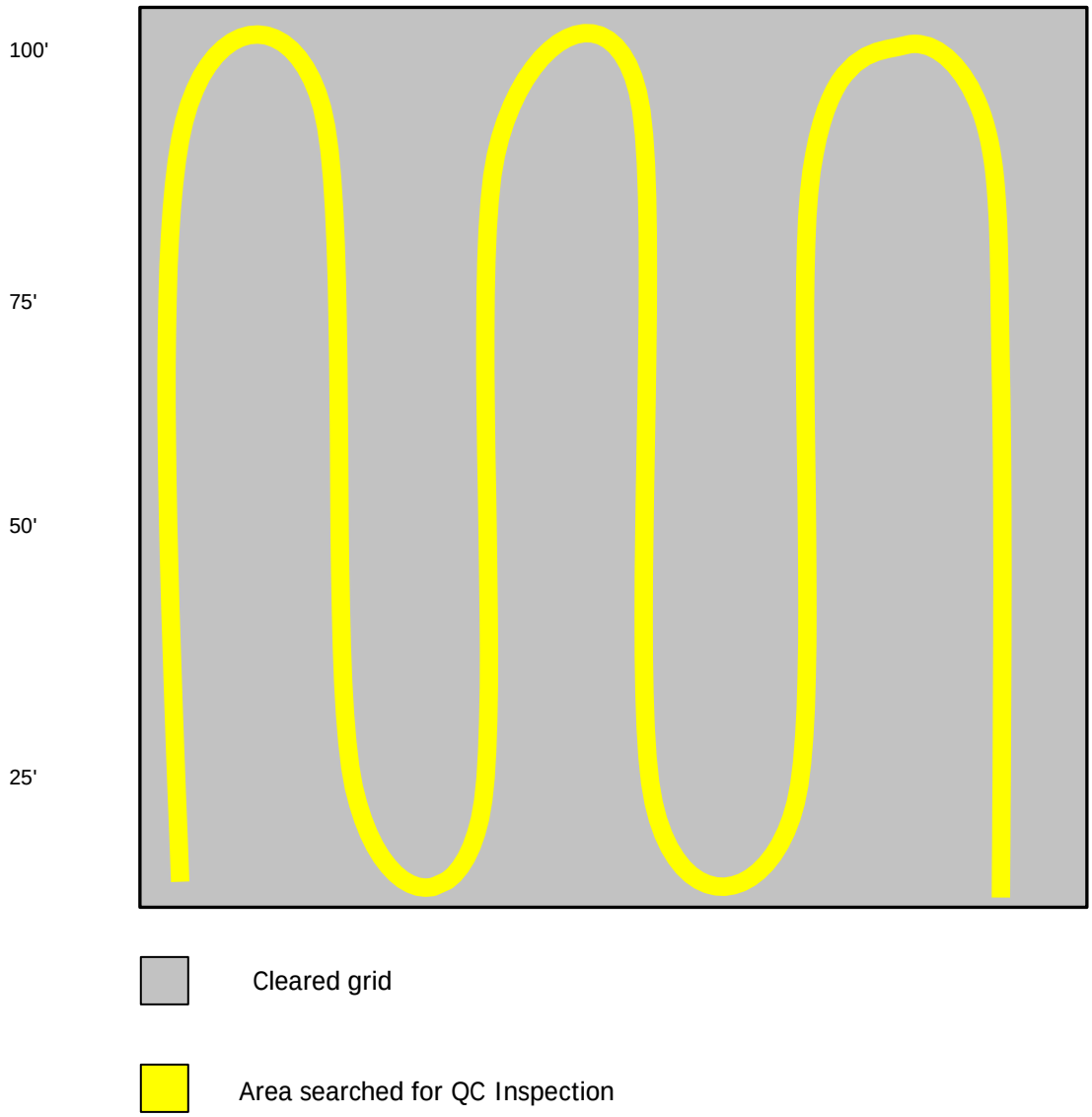


20 - Five Feet Wide Lanes

Cleared grid

Lanes randomly selected for QC

Figure 204-3
Example of 100' x 100' grid randomly sampled using zigzag pattern.



2.3 QUALITY OF GEOPHYSICAL DATA

The UXOQCS will make sure data collected by site geophysical teams is posted correctly soon after the data is collected. The CQM will then work with the geophysicist to make sure the data is complete and appropriate. During data processing, the CQM and geophysicist will make sure that the procedures are complete, appropriate and IAW the data processing SOP. Once the data is processed and anomalies selected for investigation, the CQM will review the data and make sure anomaly selection is appropriate. If it is determined that appropriate anomalies were not selected, the CQM will select those anomalies and include them on the dig sheet. These anomalies will be identified as chosen by the CQM for later analysis. The anomaly target I.D., date of review and applicable details will be entered under the appropriate grid on the JV Geo Database. Once the geophysicist creates the dig sheet, it will be reviewed by the CQM for completeness. During anomaly investigation activities, the excavation team will make sure data blocks are completed. The UXOQCS will review the completed dig sheet for completeness prior to it being returned to the geophysicist.

2.3.1 DELIVERABLES

Deliverable items will be reviewed for completeness and applicability by the CQM prior to submission to the customer. The date and details of this review will be documented on a JV QC Surveillance Report.

2.4 NONCONFORMANCE/NONCOMPLIANCE

In the event that any worked product is found by QC or Quality Assurance (QA) sampling inspection not to be in conformance with acceptance standards, the product will be withheld from acceptance and distribution. In addition, that portion of the lot that has already been completed and additional production occurring prior to initiation and validation of corrective action shall be withheld. Prior to re-inspection, the lot of non-conforming product shall be kept separate from conforming product. Once corrective actions have been validated, the nonconforming product shall be re-worked and/or re-inspected for its conformance to acceptance criteria. These non-conformances shall be documented IAW Section 2.8 of this SOP. Any procedures or processes identified during QC surveillance activities shall be halted immediately and corrective actions initiated. Any production occurring with the nonconforming procedures shall be withheld from acceptance. Once corrective actions have been validated, the nonconforming product shall be re-worked and/or re-inspected for its conformance to acceptance criteria. The SUXOS will coordinate and supervise re-performance under tightened conditions. The UXOQCS will verify performance under acceptable standards.

2.5 CORRECTIVE ACTIONS

Once the non-conforming product has been identified, a Non-Conformance/Corrective Action procedure shall be initiated. This procedure will make sure immediate corrective actions take place to return any non-conforming product to a conforming status. Corrective actions may include reworking of product for its conformance to acceptance standards. Non-conformance/corrective actions shall be documented IAW Section 2.8 of this SOP.

2.6 ROOT CAUSE ANALYSIS

In the event a nonconforming product or noncompliant procedure is discovered and corrective actions are taken to make sure of conformity, a root cause analysis will be initiated. This analysis will be performed by a team of involved personnel such as the UXOQCS, CQM, SUXOS, PM, Geophysicist, etc. The analysis will focus on the breakdown in approved procedures or the inadequacy of approved procedures in order to prevent like nonconforming occurrences. A key component of the analysis is capturing and successfully disseminating the information in order to be available to personnel for preventative use. The data gathered by the analysis will be gathered by the CQM and disseminated to appropriate personnel. Root Cause Analysis collected data is included in the Non-Conformance Report (NCR) form.

2.7 LESSONS LEARNED

Lessons learned, as a component of the JV's corrective action and root cause analysis procedures, will be captured, analyzed and disseminated in an appropriate manner as to prevent similar types of nonconformance/noncompliance. These lessons learned will be communicated to the customer with details surrounding the lesson learned.

2.8 DOCUMENTATION

Surveillance activities will be documented on a JV QC Surveillance Report. Any nonconformance/noncompliance identified during the conduct of surveillance activities will require a JV Nonconformance/Corrective Action Report including associated corrective actions. Inspections will be documented on a JV QC Inspection Report. Data Quality inspections/checks will be documented on the JV Geo/QC site specific database. Root Cause Analysis' will be recorded, depending on specific circumstances, by either an NCR, surveillance report or a memorandum. Lessons Learned will be documented either on the JV Inspection, Surveillance or Nonconformance/Corrective Action Report or memorandum. Site documentation will be kept at the project site and copies forwarded to the CQM for analysis. Forms and reports referenced in this SOP are available in the JV Quality Management System (QMS) or directly from the CQM.

3.0 REFERENCES

The following standards directly apply to the conduct of operations associated with the SOP. In the event other hazards are associated with the conduct of this SOP, consultation of other SOPs and regulatory references may be needed. Additionally, this SOP has also been designed to meet the U.S. Army Corps of Engineers (USACE) requirements outlined below.

- JV Corporate QMS
- ISO 9004:2000
- MIL-STD-1916
- USACE Engineering Manual (EM) 385-1-97, Explosive Safety and Health Requirements Manual
- USACE EM 1110-1-4009, Military Munitions Response Actions

4.0 ATTACHMENTS

No attachments associated with this SOP.

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to outline the accountability requirements and procedures associated with managing and processing Munitions and Explosives of Concern (MEC).

2.0 PROCEDURES

2.1 INSPECTION OF MATERIAL

Material to be disposed of will first be 100 percent visually inspected to make sure the removal of live rounds, primers, or explosive material occurs. Items that cannot be visually inspected will be either 100 percent physically inspected, vented, or thermally treated to make sure no explosive hazards exist. Munitions fragments, such as those found dispersed within the proximity of demolition or impact ranges will be inspected for the presence of energetic contaminants. All inspections will follow the procedures in Engineering Manual (EM) 1110-1-4009 with Errata Sheet #2.

2.1.1 Inspection Process

The inspection process will involve the steps outlined below. This multi-step process will make sure that the materials released for disposal are free of explosive hazards.

A. Unexploded Ordnance (UXO) Technician (UXOTI) will:
   1. Excavate and initially identify MEC, UXO and Discarded Military Munitions (DMM) including possible fuzing and their condition.
   2. Identify and remove non-hazardous materials not directly related to Military Munitions such as ferrous and non-ferrous scrap metals.
   3. Identify and mark material potentially presenting and explosive hazard (MPPEH) (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris) which may contain an explosive hazard for inspection and removal by a UXO Qualified Technician II or III.
   4. Initially identify and mark possible UXO, MPPEH or MEC which may contain an explosive hazard, for inspection and removal by a UXO Qualified Technician II or III.
   5. Assist the UXO TII/III in the inspection of MPPEH as directed.

B. UXO Qualified Technician (UXOTII) will:
   1. Inspect 100% of items and determine the following:
      - Is the item a UXO, MEC or component of a military munition?
      - Does the item contain explosives or other dangerous materials?
      - Does the item require detonation?
      - Does the item require demilitarization (demil) or venting to expose internal fillers and/or cavities?
   2. Segregate items requiring demil or venting procedures from those items ready for certification.

3. Items found to contain dangerous fillers will be marked or set aside for additional processing such as demolition.

C. UXO Supervisor (UXOTIII) will:
1. Inspect 100% of items recovered for proper segregation and confirm the condition of those items classified as free of dangerous fillers, residues or components.
2. Supervise and perform on-site demil of MEC.
3. Supervise detonation of items found to contain dangerous or unexposed fillers and venting/demil procedures.
4. Supervise the safety, consolidation, security and transportation of recovered material within assigned areas.
5. Complete required tracking and reporting documentation for permanent records as directed.

D. If a materials recovery team is employed, the UXO Technicians I/II/III will:
1. Respond to materials consolidation areas as directed by the Senior UXO Supervisor (SUXOS).
2. Inspect items before placing them into transport vehicle.
3. Determine separation requirements of material recovered. (i.e., materials that resembles ordnance, sort by metal types, MEC requiring processing, etc.).
4. Deliver materials to appropriate area and maintain security and segregation to prevent commingling with inspected and certified materials.

E. UXO Quality Control Specialist (UXOQCS) will:
1. Conduct surveillances of the procedures used by MEC teams and individuals for processing materials.
2. Perform and document, a minimum of 10% (100% in some cases), random sampling of materials collected from the various teams to make sure no items of a dangerous or explosives nature are identified as free from hazardous material. The UXOQCS performs these random checks to satisfy the UXOQCS that the materials are free from any explosive hazards, necessary for completion of the required documentation. UXOQCS should, during generation of small amounts, accomplish a 100% inspection of all materials. Random checks will be both during the process and at the completion/turn-in of materials to verify the method as well as the final result.
3. Inspection should be accomplished daily or not to exceed the end of the work week within which the material was recovered. Inspection will be performed prior to consolidation within a container (barrel, conex, trailer, rolloff etc.).
4. Inspect the prepared documentation and container marking and seals process. At a minimum the UXOQCS will inspect; the Requisition and Turn-in DoD Directive (DOD) document form, DD 1348-1A and Joint Venture (JV)

Form-205A, INSPECTION, CERTIFICATION, AND CHAIN OF CUSTODY, Seals, containers, labels and marking methods and verify accuracy of the information contained in documentation.

F. UXO Safety Officer (UXOSO) will:
   1. Make sure the specific procedures and responsibilities for processing materials for certification are being followed and performed safely.
   2. Confirm that operations are compliant with the Site Safety and Health Plan (SSHP)/Accident Prevention Plan (APP) and consistent with applicable regulations and guidance and in accordance with the U.S. Army Corps of Engineers (USACE) approved project work plan.
   3. Will perform and document in a timely manner and prior to containerization, random checks of no less than 10% of processed materials to make sure items being identified as scrap are safe and free from any explosive hazards. Random checks will be both during the process and at the completion/turn-in of materials to verify the method as well as the final result.

G. SUXOS will:
   1. Be responsible for making sure Work Plans and QC Plans specify the procedures and responsibilities for processing materials for the final disposition.
   2. Make sure a Requisition and Turn-in Form, DD Form 1348-1A is completed for material to be transferred.
   3. Perform in a timely manner and prior to containerization, random checks to make sure that the material is free from explosive hazards, necessary to complete the DD 1348-1A. Random checks will be both during the process and at the completion/turn-in of materials to verify the method as well as the final result.
   4. Certify material as free of explosive hazards or other dangerous material.
   5. Be responsible for making sure that inspected materials are secured in a closed, labeled and sealed container and documented as follows:
      a. The container shall be closed and clearly labeled on the outside with the following information: The first container will be labeled with a unique identification that shall start with USACE (if appropriate)/Installation Name/JV/0001/Seal's unique identification and continue sequentially.
      b. The container shall be sealed, in such a manner, that the seal must be broken in order to open the container. The seal shall bear the same unique identification as the container or the container (if feasible) shall be clearly marked with the seal's identification, if different than the container.
      c. JV Form-205A INSPECTION, CERTIFICATION, AND CHAIN OF CUSTODY will be provided to the customer and material disposal company. The following information for each container will be provided; weight of container; location where material was obtained; name of contractor,

names of certifying and verifying individuals; unique container identification; and seal identification, if required. This documentation will be included in the final report.

2.2 MARKING AND PACKAGING

Explosive free Cartridge and flare cases, fuzes, primers, boosters, practice ordnance, and small pieces/fragments from types of high explosive ordnance and other similar items DO NOT require individual marking. These items will be inspected, placed in containers, then secured or tagged with an appropriate seal or similar device having a serial number. When large amounts of residue are generated, large containers such as hoppers, securable roll-offs, conex's or other appropriate containers may be used, provided the container has a lid/cover/door that can be secured and sealed after inspection. **Any evidence of tampering after sealing will require 100% re-inspection and re-certification IAW Engineering Manual (EM) 1110-1-4009**. Containers will be marked as in paragraph 2.1.1.g. above. Where quantities permit, the contents will be separated by base metal type (i.e., copper, aluminum, steel, etc.) and tagged or marked to identify contents. Large materials that cannot be containerized or palletized will be individually inspected and marked similarly. Each will be tagged with a "railroad seal" or similar device having a serial number. When large items are further demilitarized, by smelting, disassembly, breaking, crushing, shredding, or cutting, additional stamping or marking of individual pieces is not required.

2.3 MATERIALS CERTIFICATION AND VERIFICATION

The JV will make sure that materials generated from MEC project sites is properly inspected in accordance with the procedures above. Only UXO personnel who are qualified in accordance with (IAW) Department of Defense Explosive Safety Board (DDESB) Technical Paper (TP) 18 will perform these inspections. The SUXOS will <u>certify</u>, and the client representative, or UXOQC, will <u>verify</u>, that the material is free of explosive hazards.

DD form 1348-1A will be used as documentation. DD 1348-1A forms must clearly show the typed or printed names of the SUXOS and the client representative, organization, signature, and contractor's home office and field office phone number(s) of the persons certifying and verifying the material.

a. Local directives and agreements may supplement these procedures. Coordination with the local concerns will identify any desired or requested supplement to these procedures.
b. In addition to the data elements required and any local agreed to directives, the DD 1348-1A must clearly indicate the following:
   (1) Basic material content. (Type of metal; steel, aluminum, brass, or mixed)
   (2) Estimated weight.

(3) Unique identification of each of the containers and seals stated as being turned over.
(4) Location where material scrap was obtained. (Site or Range Number)
(5) Seal identification, if different from the unique identification of the sealed container.

c. The following certification will be entered on each DD 1348-1A for turnover of material generated from MEC operations and will be signed by the SUXOS and the client representative. If there is no client representative on the project, the SUXOS will be the certifier and the UXOQCS will be the verifier.

"This certifies and verifies that the material listed has been 100 percent inspected and to the best of our knowledge and belief, are inert and/or free of explosives or related materials."

***Note**: This statement shall be IAW EM 1110-1-4009 Chapter 14. Specific requirements of the client may be incorporated. Chain of Custody form shall also reflect the appropriate statements for Certifier, Verifier and Final Disposition.*

2.4 DEMILITARIZATION

When required by Department of Defense (DoD) 4160.28M Volumes 1-3, or the Scope of Work where this directive is not applicable, material will be demilitarized to an acceptable standard before being released from JV custody. The purpose of demilitarization is to render any item unusable and/or unrecognizable as a military article. Explosives or mechanical means can be used to demilitarize an item.

Mechanical means of demilitarization must be specifically reviewed and the means and material must meet the safety requirements when considering, explosive residue's, voids, size, weight, configuration and location.

2.5 CHAIN OF CUSTODY

The containers/hoppers and individual pieces of material must be under the control and custody of the JV from the time each is inspected and certified until each is turned over to the smelter or recycler for final disposition. JV Form-205A Inspection Certification and Chain of Custody Form will be used to document this chain of custody. Form-205A identifies the quantity, composition, origin, routing, and destination of each container/hopper or item during its handling and transportation life cycle. It also provides evidence that containers/lots were properly segregated and secured until final disposition. At random intervals during the scrap process, photographs of a representative sample of containers/lots will be taken by JV personnel to verify that this SOP is being followed.

2.6 FINAL DISPOSITION

The certified and verified materials will only be released to an organization that will:

a. Upon receiving the unopened labeled containers each with its unique identified and unbroken seal making sure there is a continued chain of custody, and after reviewing and concurring with the provided supporting documentation, sign for having received and agree with the provided documentation that the sealed containers contained no explosive hazards when received. This shall be signed on company letterhead stating that the contents of these sealed containers will not be sold, traded or otherwise given to another party until the contents have been smelted and are only identifiable by their basic content.
b. Send notification and supporting documentation to the JV that the contents of the sealed containers have been smelted and are now only identifiable by their basic content. This will be incorporated into the final report as documentation for supporting the final disposition of this scrap metal.

3.0 REGULATORY REFERENCES

The following regulations outline requirements associated with managing munitions debris (MD)/range related debris (RRD) collected from MEC project sites:

- DoD 6055.9-M, DoD Ammunition and Explosive Safety Standards
- DoD Policy to Implement the EPA's Military Munitions Rule
- 40 Code of Federal Regulations (CFR) Part 261
- DOD 4160.28M (Vols 1-3), Defense Demilitarization Manual
- DoD 4145.26-M, DoD Contractor's Safety Manual for Ammunition and Explosives
- DDESB TP 16, Methodologies for Calculating Primary Fragment Characteristics
- DDESB TP 18, Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel
- DA-Pam 385-64, Ammunition and Explosives Safety Standards
- OSHA Construction Industry Standard 29 CFR Part 1926, Subparts O and P, Excavations
- USACE Engineering Regulation (ER) 385-1-92, Safety and Occupational Health Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) Activities
- USACE EM 385-1-97, Explosive Safety and Health Requirements Manual
- USACE Engineering Pamphlet (EP) 1110-1-18, Ordnance and Explosives Response
- USACE EM 200-1-15, Technical Guidance for Military Munitions Response Actions
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-95, Safety and Health Requirements for MEC Operations
- The JV Corporate Environmental Safety and Health Plan (CESHP) and Quality Management System (QMS), and SOP's (these documents will be on site and available to site personnel during the project).

4.0 ATTACHMENTS

No attachments associated with this SOP.

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the minimum procedures and safety and health requirements applicable to the acquisition, storage, and accountability of explosives and munitions and explosives of concern (MEC).

2.0 REQUISITION PROCEDURES

The requisition of explosives will be in accordance with the Joint Venture's (JV) purchasing policy to make sure of the best possible price for the task. Of paramount importance in this process is the determination of the location of the supplier(s). Generally, response time to requisitions is better for those suppliers closest to the site. Additionally, there is the possibility of leasing explosives magazines from the supplier however, it will remain the responsibility of the Senior Unexploded Ordnance (UXO) Supervisor (SUXOS) to make sure regulatory requirements are met to the greatest extent practicable. Magazines must meet the requirements of 27 Code of Federal Regulations (CFR) 55.41 and each magazine must have a Net Explosive Weight (NEW) and hazard classification established for the explosives to be stored. The NEW is calculated in accordance with the procedures identified in DA Pam 385-64.

3.0 LICENSE/PERMIT

3.1 FEDERAL LICENSE

In order to requisition explosives, the JV will have a valid Bureau of Alcohol Tobacco and Firearms (BATF) license/permit on hand, and Employer possessor forms, to include an Explosives Purchase/Receipt/Transportation Authorization List (Form-203B) for the receipt of explosives. These two documents must be on file at the JV corporate office, the project site, and each explosives supplier must also have a copy of each in order to sell to the JV.

3.2 STATE BLASTERS LICENSE

JV personnel will obtain a state blaster's license (if required). This will usually be accomplished by contacting the State Fire Marshall or Safety Office to determine the requirements and schedule for the test. Only those individuals licensed by the State may actually perform the state specified procedures. The JV Project Manager (PM) and SUXOS will be responsible for identifying the need to obtain a blaster's license for a given project and for scheduling the personnel resources needed to obtain the requisite license. Federal properties are typically exempt from this requirement, however, this must be verified prior to activity.

3.3 STATE/COUNTY PERMITS

In some instances, it is necessary to obtain a state or county permit to conduct open burn/open detonation. This is accomplished by contacting the State Fire Marshall or County Fire Department for instructions.

4.0 EXPLOSIVES RECEIPT

Only those individuals named on the authorization list and have employer possessor forms may sign for explosives from the shipper. In order to make sure that the quantity shipped is the same as the quantity listed on the shipping documents, two JV personnel will inventory the shipment prior to signing for its receipt.

4.1 SHIPPING DOCUMENTS

The explosive suppliers Bill of Lading (B/L) and the freight companies shipping document generally accompany explosive shipments (see JV Form -203A). The initial inventory will include reconciling the two documents with the actual shipment and creating an on-site record that includes these documents and the inventory records. One copy of the B/L and the freight company's shipping document will be kept on file on site and **one complete copy forwarded to the corporate office.**

4.2 RECEIPT DISCREPANCIES

In the event there is a discrepancy between the amount shipped and the amount received, the SUXOS will immediately contact the explosive supplier and inform the supplier of the discrepancy. It is then the responsibility of the supplier and shipper to rectify the situation and inform the JV of the results. The supplier and/or shipper must then correct their documents and forward the corrected documents to the site. Only the amount received will be entered on the Explosives Accountability Record/Magazine Data Card (DD Form 3020-R). Discrepancies and follow up activities will be annotated in the SUXOS Log.

5.0 EXPLOSIVES STORAGE

To the maximum extent possible, local government or existing facilities will be used for the storage of explosives demolition materials. Existing facilities are desirable due to their low cost and pre-approval, negating transport and set up. The JV will comply with local storage procedures when using Government facilities. When required to provide explosive storage facilities, the JV will:

- Use approved BATF Type 2 outside storage structures or government furnished magazines;
- Locate, install, and maintain the magazines to comply with the magazine criteria

and quantity distance requirements established in Department of Defense (DoD) 6055.9-M, DoD Ammunition and Explosives Safety Standards, 27 CFR 55.41, 29 CFR 1910.1201 and local, and state requirements to the greatest extent;

- Install a lightning protection system (LPS) and grounding, and have it checked by an electrician for specification conformance. Inspection and testing criteria are contained in National Fire Protection Agency (NFPA) 780, U.S. Army Corps of Engineers (USACE) Engineering Manual (EM) 385-1-97, and DA Pam 385-64;
- A physical security survey will be conducted in accordance with AR 190-11 to determine if fencing or guards are required. Establish security, such as fencing and lighting as needed, to prevent unauthorized access and theft.

5.1 MAGAZINES

Generally, Type 2 outdoor magazines conforming to the standards set forth in Section 55.208 of ATFP 5400.7. Alcohol, Tobacco, and Firearms (ATF) Explosives Law and Regulations will be used, which will consist of a box, trailer, semi-trailer, or other mobile facility. Type 2 magazines are bullet, fire, weather, and theft-resistant and must be ventilated. The ground around outdoor magazines must slope away for drainage or other adequate drainage provided.

5.1.1 Exterior Construction

The exterior and doors are to be constructed of not less than 1/4-inch steel and lined with at least two inches of hardwood. Magazines with top openings will have lids with water-resistant seals or which overlap the sides by at least one inch when in a closed position.

5.1.2 Hinges and Hasps

Hinges and hasps will be attached to doors by welding, riveting or bolting (nuts on inside of door). Hinges and hasps will be installed so they cannot be removed when the doors are closed and locked.

5.1.3 Locks

Each door will be equipped with two padlocks fastened in separate hasps and staples. Padlocks must have at least five tumblers or five blades and a casehardened shackle of at least 3/8-inch diameter. Padlocks will be protected with not less than 1/4-inch steel hoods constructed to prevent sawing or lever action on the locks, hasps, and staples.

5.1.4 Signs/Placards

The BATF and the DoD require that magazines be appropriately posted to indicate the hazard class of the contents, the firefighting hazards and the emergency notification list. Magazines will be placarded in accordance with DoD 6055.9-M and DA Pam 385-64. This will require that the magazine area be posted for the most hazardous items stored in the magazine area. If there are two fire division or hazard class items in the same magazine, use the higher hazard division/class placard.

5.1.5 Lightning Protection

For Base Realignment and Closure (BRAC) and active military facilities, appropriate lightning protection will be installed in accordance with Volume 2 Enclosure 4 of DoD 6055.9-M. Army installations will also meet the provisions of DA Pamphlet 385-64 Chapter 12. For Formerly Used Defense Sites (FUDS) where existing storage facilities are typically not available, lightning protection is not required if the following criteria are met

- The magazine is constructed of metal that is 3/16-inch steel or larger (reference Appendix L of NFPA 780), and
- The magazine is grounded in accordance with (IAW) NFPA requirements, and
- The parts of the magazine are located at least 6.5 feet from the nearest fence.

5.1.6 Emergency Notification List

An emergency notification list containing the name, telephone number and local address of the individuals to be notified in the event of an emergency, will be posted on the outside and inside of the magazine door. These individuals should be the same individuals authorized to sign for explosives.

5.1.7 Compatibility

Explosive compatibility will be maintained. Table No. 206-1 lists the various storage compatibility groups and Table No. 206-2 is the compatibility chart. These tables are extracts from Section 7 of DA PAM 385-64. In certain instances, it may be necessary to store incompatible items in the same magazine. If this should occur, then a barricade, such as sandbags, within the magazine, will physically separate the incompatible items. This situation should be an interim occurrence to be avoided if possible, and for DoD projects will be approved by the Department of Defense Explosives Safety Board (DDESB) prior to implementation.

5.1.8 Key Control

Magazines will remain locked except when explosive receipt, issue or accountability operations are being conducted. The two locks on the magazines will require two different keys to unlock. The SUXOS will maintain one copy of the key, and will designate control of the second key to the UXO Safety Officer (UXOSO), the UXO

Quality Control Specialist (UXOQCS), or a UXO Technician III assigned as the demolition supervisor (DS). This procedure makes sure that access to the magazines cannot be made without obtaining the two keys and no one individual can gain access to the magazines. In instances where provided storage areas such as earthen covered bunkers, inspection of the facilities and coordination with the installation or client may be necessary to meet these requirements by addition or modification of facilities or procedures. Written documentation will be generated with the defined procedures as applicable to the situation and all feasible coordination's will be made to accomplish these requirements as closely as possible. Key sign-out rosters will be utilized at all times and keys will be issued and received for accountability and control.

The requirements for locks used on ordnance and explosives (OE) storage magazines at BRAC and Installation Restoration (IR) sites will be determined using the installation's service criteria. A key control system will be documented in the Work Plan.

TABLE 206-1: STORAGE COMPATIBILITY GROUPS FOR EXPLOSIVES AND AMMUNITION

Group	Description	Type Ammo/Explosive
A	Bulk initiating explosives that have the necessary sensitivity to heat, friction, or percussion to make them suitable for use as initiating elements in an explosives train.	Wet lead azide, wet lead styphnate, wet mercury fulminate, wet tetracene, dry cyclonite (RDX), and dry pentaerythritol tetranitrate (PETN).
B	Detonators and similar initiating devices not containing two or more independent safety features. Items containing initiating explosives that are designed to initiate or continue the functioning of an explosives train.	Detonators, blasting caps, small arms primers, and fuzes.
C	Bulk propellants, propelling charges, and devices containing propellant with or without their own means of ignition. Items that, upon initiation, will deflagrate, explode, or detonate.	Single-, double-, triple-base and composite propellants, rocket motors (solid propellant), and ammunition with inert projectiles.
D	Black powder, high explosives (HE), and ammunition that contain HE without its own means of initiation and without propelling charge, or a device containing initiating explosives and containing two or more independent safety features. Ammunition and explosives that can be expected to explode or detonate when any given item or component thereof is initiated except for devices containing initiating explosives with independent safety features.	Bulk trinitrotoluene (TNT), Composition B, black powder, wet RDX or PETN, bombs, projectiles, cluster bomb units (CBUs), depth charges, and torpedo war- heads.
E	Ammunition or devices containing HE without its own means of initiation and containing propelling charges (other than one containing a flammable or hypergolic liquid).	Artillery ammunition, rockets, or guided missiles.
F	Ammunition containing HE with its own means of initiation and with propelling charge (other than one containing a flammable or hypergolic liquid) or without a propelling charge.	Grenades, sounding devices, and similar items having an in-line explosives train in the initiator.
G	Fireworks, illuminating, incendiary, and smoke, including hexachloroethane (HC) or tear-producing munitions other than those munitions that are water activated or which contain white phosphorous (WP) or flammable liquid or gel. Ammunition that, upon functioning, results in an incendiary, illumination, lachrymatory, smoke, or sound effect.	Flares, signals, incendiary or illuminating ammunition, and other smoke or tear-producing devices.
H	Ammunition containing both explosives and WP or other pyrophoric material. Ammunition in this group contains fillers which are spontaneously flammable when exposed to the atmosphere.	Plasticized white phosphorous (PWP), or other ammunition containing pyrophoric material.
J	Ammunition containing both explosives and flammable liquids or gels (other than those which are spontaneously flammable when exposed to water or the atmosphere).	Liquid- or gel-filled incendiary ammunition, fuel-air ex plosives (FAE) devices, flammable liquid-fueled missiles, and torpedoes.
K	Ammunition containing both explosives and toxic chemical agents. Ammunition in this group contains chemicals specifically designed for incapacitating effects more severe than lachrymation.	Artillery or mortar ammunition (fuzed or un-fuzed), grenades, and rockets or bombs filled with a lethal or incapacitating chemical agent.
L	Ammunition and explosives not included in other compatibility groups. Ammunition or explosives having characteristics that do not permit storage with other types of ammunition or kinds of ex- plosives or dissimilar ammunition of this group. Note: Ammunition/ explosives presenting same or similar risks within this group may be stored together. However, items with dissimilar risks within this group must be kept separate.	Water-activated substances, phosphides, and pyrophoric substances and devices containing these substances; hypergolics and hypergolic prepackaged liquid - fueled rocket engines; TPA (thickened TEA) and damaged or suspect ammunition of any group.
N	Ammunition containing only extremely sensitive detonating substance (EIDS). Note: If dissimilar Group N munitions are mixed together and have not been tested to assure non-propagation, then the mixed munitions are considered to be Hazard Division 1.2, compatibility Group D for purposes of transportation and storage.	Bombs and warheads.
S	Ammunition presenting no significant hazard. Ammunition so pack- aged or designed that any hazardous effects arising from accidental functioning are confined within the package unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not hinder firefighting.	Thermal batteries, explosives switches or valves, and other ammunition items packaged to meet the criteria.

TABLE 206-2: STORAGE COMPATIBILITY CHART

Group	A	B	C	D	E	F	G	H	J	K	L	N	S
A	X	Z											
B	Z	X	Z	Z	Z	Z	Z					X	X
C		Z	X	X	X	Z	Z					X	X
D		Z	X	X	X	Z	Z					X	X
E		Z	X	X	X	Z	Z					X	X
F		Z	Z	Z	Z	X	Z					Z	X
G		Z	Z	Z	Z	Z	X					Z	X
H								X					X
J									X				X
K										Z			
L													
N		X	X	X	X	Z	Z					X	X
S		X	X	X	X	X	X	X	X			X	X

Notes:

1. "X" indicates that these groups may be combined in storage; otherwise, mixing is either prohibited or restricted according to note #2. A “Z” at an intersection indicates that when warranted by operational considerations or magazine non-availability, and when safety is not sacrificed, mixed storage of limited quantities of some items from different groups may be approved in writing. Approval of such storage will be at a level consistent with the risk acceptance authority criteria of DA Pam 385–30, table 4–2; however, a DA Form 7632 (Certificate of Risk Acceptance) is not required. Documentation of this approval must be kept on hand by the installation or garrison safety office. Mixed storage of items within groups where no X or Z exists at that pair’s intersection beyond the prohibitions and limitations of note 7 below: however, requires a Certificate of Risk Acceptance per DA Pam 385–30. U.S. Army Technical Center for Explosives Safety (USATCES) shall determine which items may be stored with Group K. Group K may also require separate storage within the group. Articles of compatibility Groups B and F shall each be segregated in storage from articles of other compatibility groups by means that are effective in preventing propagation of those articles through fire or detonation (a sand bag wall at least one foot thick and high enough to prevent line of sight exposure will provide this protection). Examples of acceptable storage combinations are: (a) HD 1.1A initiating explosives with HD 1.1B fuzes not containing two or more effective protective features; (b) HD 1.3C bulk propellants or bagged propelling charges with HD 1.3G pyrotechnic substances.
2. Compliance with compatibility criteria is not required for mission essential or operationally necessary quantities of explosives in class/division 1.4 or 6.1 (excluding toxic chemical munitions); up to 100 lbs. NEW class/division 1.3; and up to 50 lbs. NEW Class/Division 1.2.2. See paragraph 8–2b for QD requirements and additional information concerning small quantities of explosives.
3. Equal numbers (to the nearest pack or pallet as applicable) of separately packaged components of complete rounds of any single type of ammunition may be stored together. When so stored, compatibility is that of an assembled round, for example, white phosphorus (WP) filler in Group H, high explosive (HE) filler in Groups D, E, or F, as appropriate
4. Ammunition items without explosives that contain substances properly belonging to another U.N. hazard class may be assigned to the same compatibility group as items containing explosives and the same substance, and be stored with them.
5. DA may authorize ammunition designated ’practice’ by National Stock Number (NSN) and nomenclature to be stored with the fully loaded ammunition it simulates.

6. In addition to the authority in paragraph 7-4b, above, and Z compatibility storage in Note 2 above, the ACOM, ASCC, or DRU may also authorize the mixing of compatibility groups in quantities not exceeding 1000 pounds NEW per storage site; EXCEPT items in Groups A, K, and L.
7. For purposes of mixing, all items must be packaged in approved storage/shipping containers. Items shall not be opened for purposes of issuing unpackaged munitions in storage locations. Outer containers may be opened in storage locations for inventorying; for removing munitions still inside an approved inner package in limited amounts, and for magazines storing only hazard division 1.4 items, unpacking, inspecting, and repacking the hazard division 1.4 ammunition.
8. If dissimilar Compatibility Group (CG) N munitions are mixed together and have not been tested to ensure non-propagation; the mixed munitions are considered to be HD 1.2, CG D for purposes of transportation and storage. When mixing CG N munitions with CGs B through G, see paragraph 8-7 about changing QD class/divisions.
9. For storage purposes, fuzes assigned to CG D are also compatible with fuzes assigned to CG B.

6.0 EXPLOSIVES ACCOUNTABILITY

Upon receipt and verification of explosive demolition material, the Explosives Accountability Record/Magazine Data Card (DD Form 3020-R) is completed and kept in the magazine on top of the listed item. A duplicate copy will be generated and those copies maintained by the UXOQCS/UXOSO/DS as designated.

6.1 USAGE INVENTORY

During each occurrence of a receipt or issue of explosive material, the person drawing out or returning the explosives will fully inventory those items issued/returned. The second person will perform an additional count of materials issued/returned. These quantities will be compared and upon concurrence, the personnel will appropriately annotate the two sets of magazine data cards.

6.2 WEEKLY INVENTORY

The last day of each work week, the SUXOS, UXOSO or the UXOQCS, and a second individual (who will be changed each week) will conduct a complete inventory and record results on the two sets of magazine data cards. Data cards will be reviewed for completeness, accuracy and legibility. The weekly receipt and usage report will be completed and forwarded to the corporate office.

6.3 LONG TERM STORAGE

In the event long term storage in excess of 30 calendar days is anticipated or through unforeseen events short term storage surpasses 30 calendar days when no JV personnel are present on-site for inventory, inspection and control purposes, additional guidance must be obtained through the corporate office for disposition of explosive materials such as disposal of materials, return to the supplier or off-site shipment to an active project. Alternative measures may also include retaining a licensed security firm for external facility inspection and surety.

6.4 DISCREPANCIES

If it is discovered that explosive items have been lost, stolen or used without proper authorization, proper authorities shall be notified in writing within 24 hours of the event. The JV PM will immediately notify the Commanding Officer (CO) by telephone and follow up with a written report within 24 hours. The JV PM, will also notify the Installation Point of Contact (POC), Client PM and BATFE.

7.0 REGULATORY REFERENCES

This SOP has been designed to addresses the operational and safety and health concerns associated with the acquisition, storage and accountability of explosives and MEC. This SOP will be used in conjunction with JV SOP-203, Transportation of Explosives, and the applicable specifications of the Occupational Safety and Health Administration (OSHA) standards and USACE requirements listed below. Additional Federal regulations are also presented below, and in the event other hazards are associated with the conduct of this SOP, consultation of other JV SOP's and SOPs may be needed.

- OSHA 29 CFR 1910 General Industry Standards
- OSHA 29 CFR 1926 Construction Standards
- DoD 6055.9-M, DoD Ammunition and Explosive Safety Standards
- DoD 4145.26-M, DoD Contractor's Safety Manual for Ammunition and Explosives
- DDESB TP 16, Methodologies for Calculating Primary Fragment Characteristics
- DDESB TP 18, Qualifications for UXO Technicians and Personnel
- DA-Pam 385-64, Ammunition and Explosives Safety Standards
- USACE Engineering Regulation (ER) 385-1-92, Safety and Occupational Health Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) Activities
- USACE Engineering Manual (EM) 385-1-97, Explosive Safety and Health Requirements Manual
- USACE EP 1110-1-18, Ordnance and Explosives Response
- USACE EM 1110-1-4009, Military Munitions Response Actions
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-95, Safety and Health Requirements for MEC Operations
- Alcohol Tobacco and Firearms (ATF) P 5400.7, ATF-Explosives Law and Regulations (most current version).
- NFPA 780, Standards for the Installation of Lightning Protection Systems

- The JV Corporate Environmental Safety and Health Plan (CESHP) and Quality Management System (QMS) and SOP's (these documents will be on site and available to site personnel during the project).

8.0 ATTACHMENTS

No attachments associated with this SOP.

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the minimum procedures and safety and health requirements applicable to the conduct of demolition/disposal operations on sites contaminated with munitions and explosives of concern (MEC).

2.0 GENERAL OPERATIONAL AND SAFETY PROCEDURES

During demolition operations, the general safety provisions listed below shall be followed by demolition personnel. Non-compliance with the general safety provisions listed may result in positive discipline, to include termination of employment. The safety provisions for demolition operations in accordance with (IAW) with the approved Work Plan (WP), Explosives Safety Plan (ESP), Explosives Ordnance Disposal (EOD) Technical Manual (TM) 60A-1-1-31, and Engineering Manual (EM) 385-1-97 include:

- Demolition operations shall be conducted IAW this SOP and any approved changes outlined in the approved WP.
- Complying with safety regulations applicable to demolition range activities, demolition materials, and MEC materials.
- Demolition of any kind is prohibited without the express permission from the client.
- The quantity of MEC to be destroyed during any single shot will be determined by the range limit net explosive weight (NEW) as established in the Approved ESP and other considerations outlined in the project WP.
- For projects where MEC items may be consolidated for demolition, the US Army Engineering and Support Center, Huntsville (CEHNC), document entitled, Procedures for Demolition of Multiple Rounds (Consolidated Shots) on Ordnance and Explosives (OE) Sites, will be located on-site and followed when destroying multiple munitions by detonation on site.
- In the event of an electrical storm, or heavy snow or dust storms are within 10 miles, immediate action will be taken to cease demolition range operations and evacuate the area.
- In the event of a fire or unplanned explosion, if possible, put out the fire, if unable to do so, notify fire department and evacuate the area. If injuries are involved, remove victims from danger, administer first aid and seek medical attention.
- The Demolition Supervisor (DS) is responsible for reporting to the Unexploded Ordnance Safety Officer (UXOSO) injuries, accidents or near misses that occur during demolition operations.
- Employees will not tamper with any safety devices or protective equipment.

- Any defect or unusual condition noted that is not covered by this SOP will be reported immediately to the DS or UXOSO, and operations will be halted until the condition is addressed and resolved.
- Adequate fire protection and first aid equipment shall be provided.
- Personnel engaged in the destruction of MEC shall wear under and outer garments made of natural fiber, close-weave clothes, such as cotton. Synthetic material such as nylon is not authorized unless treated with anti-static material.
- Consistent with the Joint Venture's (JV) operational policies, exposures to demolition hazards shall be maintained to the fewest number of personnel, for the shortest time, and to the least amount of hazard.
- Work locations will be maintained in a neat and orderly condition.
- Hand tools shall be inspected prior to use, and maintained in a good state of repair.
- Heavy equipment use in support of the demolition operations and heavy equipment operators will meet the requirements of JV SOP-518.
- Equipment and other lifting devices designed and used for lifting will have the load rating and date of next inspection marked on them. The load rating will not be exceeded and the equipment will not be used without a current inspection date.
- Leather or leather-palmed gloves will be worn when handling wooden boxes, munitions or MEC.
- Lifting and carrying require care. Improper methods cause unnecessary strains. Observe the following preliminaries before attempting to lift or carry:
  - When lifting, keep your arms and back as straight as possible, bend your knees and lift with your leg muscles, and
  - Be sure you have good footing and hold, and lift with a smooth, even motion.
- Telephone and/or radio communications with off-site emergency response shall be available and maintained throughout demolition operations.
- Motor vehicles and material handling equipment (MHE) used for transporting MEC or demolition materials must be IAW SOP-203 Transportation of Explosives.
- Employees are required to wear leather or rubber gloves when handling demolition materials. The type of glove worn is dependent on the type of demolition material.
- If required and if a designated demolition range is established and used, a red warning flag, such as a "Bravo Flag" or a windsock, will be displayed at the entrance to the demolition range during demolition operations. If a gate is available, the entrance gate shall be either guarded or locked when demolition work is in process.

- Demolition shots will be performed IAW with any engineering controls (i.e., soil tamping or sandbags) outlined in the project WP and specific Department of Defense Explosives Safety Board (DDESB) and CEHNC references.
- An observer will be stationed at a location where there is a good view of the air and surface approaches to the demolition range before material is detonated. It shall be the responsibility of the observer to order the DS to suspend firing if any aircraft, vehicles or personnel are sighted approaching the general demolition area.
- Two-way radios shall not be operated inside the restriction zones due to the potential of the electromagnetic radiation (EMR) effect to the shot being, or having been primed. The charts shown in Tables 207-2 and 207-3 (located at the end of this document) shall be used to calculate minimum safe distances as they relate to mobile Radio Frequency (RF), television and Frequency Modulation (FM) broadcasting transmitters when electric detonators are in use.
- No demolition operation will be left unattended during the active portion of the operation (i.e., during the burn or once any explosives or MEC are brought to the range).
- For established demolition ranges, a minimum area of 200 feet in diameter around the demolition pit shall be cleared of dry grass, leaves, and other combustible materials.
- No demolition activities will be conducted if there is less than a 2,000-foot ceiling or if wind velocity is in excess of 20 mph.
- Demolition shots must be fired during daylight hours (i.e., no sooner than 30 minutes after sunrise and will be completed no later than 30 minutes before sunset). Site specific restrictions may confine activities to a smaller timeframe or day schedule.
- No more than two persons shall ride in a truck transporting demolition material or MEC, and no person shall be allowed to ride in the trailer/bed.
- Vehicles shall not be refueled when carrying demolition material or MEC, and if they must be refueled near such materials, the vehicle will be a minimum of 100 feet from magazines or trailers containing such items before refueling can occur.
- Explosive vehicles will be cleaned of visible explosive and other contamination before releasing the vehicles for other tasks.
- Prior to conducting any other task, personnel shall wash their face and hands after handling demolition material or MEC.
- For established demolition ranges, demolition pits shall be spaced at least 50 feet apart, with no more than 10 pits prepared for a series of shots at any one time.

3.0 SPECIAL REQUIREMENTS FOR DEMOLITION ACTIVITIES

The following safety and operational requirements shall be followed during demolition range operations. Any deviations from this procedure shall be allowed only after receipt of written approval from the JV Project Manager (PM) and the client. Failure to adhere to the requirements and procedures listed in the paragraphs below could result in serious injury or death; therefore, complete compliance with these requirements and procedures will be strictly enforced.

3.1 GENERAL REQUIREMENTS

The general demolition range requirements listed below shall be followed:

- Demolition operations will comply with Attachment 1 of this SOP, Explosive Hazards Tables.
- Material awaiting destruction shall be stored at not less than intra-line distance, based on the largest quantity involved, from adjacent explosive materials and from explosives being destroyed. The material shall be protected against accidental ignition or explosion from fragments, grass fires, burning embers or detonating impulses originating in materials being destroyed.
- MEC items or bulk explosives to be destroyed by detonation shall, whenever feasible or required by the project WP, be detonated utilizing sandbag/water mitigation, buried explosion module (BEM) or open surface detonation procedures.
- Detonations will be counted to ensure no misfires have occurred. After each series of detonations, a search shall be made of the surrounding area for unexploded MEC. When deemed safe, items such as lumps of explosives or unfuzed ammunition may be picked up and prepared for the next shot. Fuzed ammunition or items, which may have internally damaged components, will be detonated in place, if possible.
- Prevailing weather condition information will be obtained from the U.S. Weather Service and the data logged in the Demolition Shot Log (Form-205B) before explosive operations begin.
- Shots shall be dual primed.
- A minimum of 30 seconds will be maintained between each detonation.
- After each detonation and at the end of each day's operations, surface exposed scrap metal, casings, fragments, and related items shall be recovered from the demolition range and disposed of IAW contractual procedures, as well as applicable environmental regulations. Collected scrap metal will be 100% inspected for absence of explosive materials by demolition range personnel and the DS.
- When operated in accordance with the conditions of this procedure the demolition range should not present a noise problem to the surrounding community. However, if a noise complaint is received, the name, address and

phone number of the complainant should be recorded and reported to the Senior UXO Supervisor (SUXOS), who in-turn, will report it to the client.

- Whenever possible, during excavation of the demolition pits, contour the ground so that runoff water is channeled away from the pits. If demolition operations are discontinued for more than two weeks, the pits should be back filled until operations resume.
- Upon completion of the project, disturbed demolition areas will be thoroughly inspected for MEC. Depending upon contract requirements, the site may have to be leveled, seeded and mulched to establish a permanent vegetative cover to inhibit erosion. If necessary, this will be coordinated with the contractor representative. At a minimum, the holes/pits will be filled in and contoured.
- Prior to and after each shot, the JV Demolition Shot Record (Form-205B) is to be filled out by the DS with applicable information. This record will be kept with the Explosives Accountability Record/Magazine Data Card (DD 3020-R) and reflect the data for each shot.

3.2 ELECTRIC DETONATOR USE

The following requirements are necessary when using electric detonators and blasting circuits:

- Electric detonators and electric blasting circuits may be energized to dangerous levels from outside sources such as static electricity, induced electric currents and radio communication equipment. Safety precautions will be taken to reduce the possibility of a premature detonation of the electric detonator and explosive charges of which they form a part. Radios will not be operated in the affected range while the pit is primed or during the priming process.
- The shunt shall not be removed from the leg wires of the detonator until the continuity check of the detonator.
- When uncoiling or straightening the detonator leg wires, keep the explosive end of the detonator pointing away from the body and away from other personnel. When straightening the leg wires, do not hold the detonator itself, rather hold the detonator leg wires approximately one inch from the detonator body. Straighten the leg wires by hand, do not throw or wave the wires through the air to loosen them.
- Prior to use, the detonators shall be tested for continuity. To conduct the test, barricade the detonators in a pre-bored hole in the ground or place them in or under a sand bag and walk facing away from the detonators and stretch the wires to their full length, being sure to not pull the detonators from the hole or sand bag. With the leg wires stretched to their full length, test the continuity of the detonators one at a time by un-shunting the leg wires and attaching them to the galvanometer and checking for continuity. After the test, re-shunt the wires by twisting the two ends together. Repeat this process for each detonator until

detonators have been tested. This process shall be accomplished at least 50 feet and downwind from any MEC or demolition materials and out of the demolition range, personnel and vehicle traffic flow pattern.

NOTE: When testing the detonator, prior to connecting the detonator to the firing circuit, the leg wires of the detonator must be shunted by twisting the bare ends of the wires together immediately after testing. The wires shall remain short-circuited until time to connect them to the firing line.

- At the power source end of the blasting circuit, the ends of the wires shall be shorted or twisted together (shunted), except when actually testing the circuit or firing the charge. The connection between the detonator and the circuit firing wires must not be made unless the power end of the firing wires are shorted and grounded or the firing panel is off and locked.
- The firing line will be checked using pre-arranged hand signals or using two-way radios if the demolition pit is not visible from the firing point. If radios are used, communication shall be accomplished a minimum of 50 feet from the demolition pit and detonators. The firing line will be checked for electrical continuity in both the open and closed positions, and will be closed/shunted prior to connecting the detonator leg wires.
- MEC to be detonated/vented shall be placed in the demolition pit and the demolition material placed/attached in such a manner as to make sure of the total detonation/venting of the MEC. Once the MEC and demolition material are in place and the shot has been tamped (if required), the detonators will be connected to the demolition material. Prior to handling any detonators that are connected to the firing line, personnel shall make sure that they are grounded. The detonators will then be carried to the demolition pit with the end of the detonators pointed away from the individual. The detonators are then connected to the detonation cord, Non-EI, etc., making sure that the detonator is not covered with tamping material to allow for ease of recovery/investigation in the event of a miss-fire.
- Prior to making connections to the blasting machine, the entire firing circuit shall be tested with a galvanometer for electrical continuity and ohm resistance to make sure the blasting machine has the capacity to initiate the shot.
- The individual assigned to make the connections at the blasting machine or panel will not complete the circuit at the blasting machine or panel and will not give the signal for detonation until satisfied that personnel in the vicinity have been evacuated to a safe distance. When in use, the blasting machine or its actuating device shall be in the blaster's possession. Prior to initiating a demolition shot(s), a warning will be given, the type and duration of such will be determined by the prevailing conditions at the demolition range. At a minimum, this should be a loud verbal or an audible signal using a siren, air horn, or

megaphone, five minutes prior to the shot and again one minute prior to the shot. Radio communications may be substituted when in a secured area.

3.3 DETONATING CORD USE

The following procedures are required when using detonating cord (det cord):

- Det cord should be cut using approved crimpers and only the amount required should be removed from inventory.
- When cutting det cord, the task should be performed outside the magazine at least 50 feet from the magazine.
- For ease of inventory control, only remove det cord in one-foot increments eg. 10’ or 11’ not 10’ 6”.
- Det cord should not be placed in clothing pockets or around the neck, arm or waist, and should be transported to the demolition location in either an approved "day box" or a cloth satchel, depending upon the magazine location and proximity to the demolition area.
- Det cord should be placed at least 50 feet away from detonators and demolition materials until ready for use. For consistent safe handling, each classification of demolition material shall be separated by at least 50 feet until ready for use.
- When ready to "tie in" either the det cord to demolition materials, or det cord to detonator, the det cord will be connected to the demolition material and secured to the MEC. The cord is then strung out of the hole and secured in place with soil, being sure to leave a minimum tail of 1 foot exposed outside the hole.
- Once the hole is filled, make a loop in the det cord large enough to accommodate the detonator, place the detonator in the loop and secure it with tape. The detonators explosive end will face down the det cord toward the demolition material or parallel to the main line.
- Make sure there is sufficient det cord extending out of the hole to allow for ease of detonator attachment and detonator inspection/replacement should a misfire occur.
- If the det cord detonators are electric, they will be checked, tied in to the firing line and shunted prior to being taped to the loop. If the det cord detonators are non-electric, the time/safety fuse will be prepared with the igniter in place prior to taping the detonators to the det cord loop. If the det cord detonators are Non-El, simply tape the detonators into the loop as described above.
- In the event that a time/safety fuse is used, and an igniter is not available and a field expedient initiation system is used (i.e., matches), do not split the safety fuse until the detonator is taped into the det cord loop.

3.4 TIME/SAFETY FUSE USE

The following procedures are required when using a time/safety fuse:

- Prior to each daily use, the burn rate for the time/safety fuse must be tested to make sure the accurate determination of the length of time/safety fuse needed

to achieve the minimum burn time of five minutes needed to conduct demolition operations.

- To make sure both ends of the time/safety fuse are moisture free, use approved crimpers to cut six inches off the end of the time/safety fuse roll and place the six inch piece in the time/safety fuse container.
- If quantity allows, accurately measure and cut off a six foot long piece of the time/safety fuse from the roll.
- Take the six-foot section out of the magazine or area and attach a fuse igniter.
- In a safe location, removed from demolition materials and MEC, ignite the time/safety fuse, measure the burn time from the point of initiation to the "spit" at the end, and record the burn time in the DS's Log.
- To measure the burn time, use a watch with a second hand or chronograph.
- To calculate the burn rate in seconds per foot, divide the total burn time (in seconds) by the length (in feet) of the test fuse.
- Whenever using time/safety fuse, for demolition operations, the minimum amount of fuse to be used for each shot will be the amount needed to permit a safe return of all personnel to the firing and/or security points and a burn time of no less than six minutes.

3.5 PERFORATOR USE

The following procedures are required when using perforators:

- Only remove from inventory the number of perforators required to perform the task.
- Transport perforators in an approved “day box,” or original container.
- Keep perforators stored at the demolition site at least 50 feet away from detonators and demolition materials until ready for use.
- When ready to use, affix the det cord to the perforator and knot the det cord after the last perforator in line, making sure the cord fits securely and has good continuity with the perforator.
- Once the det cord is secure, place the perforator in the desired location and secure it in place with tape or soils.
- Proceed from this point as described in Paragraph 3.3.

3.6 USE OF TWO-COMPONENT EXPLOSIVES

The following procedures are required when using two-component demolition materials:

- Only remove from inventory the amount of two-component required to perform the task.
- When transporting the solid and liquid, they need only be placed apart in the bed of a truck and in appropriate containers.
- Do not mix the solid and liquid components until certain that it will be used, since the resulting mixture is classified as a Class 1.1 explosive by Department of Transportation.

- When mixing the solid and liquids components, follow the manufacturer's instructions, while being sure to wear rubber gloves and goggles. Mix components in an area 50 feet downwind from other demolition materials, the MEC, and if possible, sheltered from the wind.
- Once the components have been mixed, it is essential that the lid to the solid bottle is put on securely as soon as possible after mixing to prevent evaporation of the liquid.
- Attach the det cord as recommended by the manufacturer, place the assembled unit in the desired location in the hole and secure the unit.
- Proceed from this point as described in Paragraph 3.3.

3.7 USE OF THE MILITARY-HARDENED REMOTE FIRING DEVICE (MHRFD)

The following short step procedures should be used when using the MHRFD during field operations. A complete review of the operations instructions and maintenance procedures is required prior to testing or firing the MHRFD in the General Dynamics Ordnance and Tactical Systems Manual or the applicable manual on the Remote Firing Device (RFD) being used.

WARNING

Hazardous voltage exist inside the receiver unit. Do not strike, tamper with, or attempt to remove or investigate the contents. Tampering with this equipment may damage the MHRFD and can cause serious bodily injury or death.

WARNING

The Stinger shock tube adapter should **never** be attached while the receiver is armed.

WARNING

Hazardous, potentially fatal voltages exist on the metal binding posts when the MHRFD receiver is fired. Contact with the posts may result in serious bodily injury or death. The binding posts are shunted and electronically isolated from the high voltage circuitry prior to firing and again one second after firing.

WARNING

In the event of a misfire, follow misfire and troubleshooting procedures in the applicable manual to determine the cause of the misfire. Do not use failed receivers with live explosives.

WARNING

The MHRFD should always be test fired, following local agency procedures, before using live explosives. An MHRFD which has not been test fired may malfunction, resulting in serious bodily injury or death. A typical test firing procedure is provided in Section 4.3.1. of the General Dynamics Ordnance and Tactical Systems Manual.

Live Fire procedures

Follow these procedures when using the MHRFD in live fire.

- Perform a site survey to determine positioning of the transmitter, receiver, detonator/cap and explosives.
- Test Fire the MHRFD according to Paragraph 4.3.1 of the General Dynamics Ordnance and Tactical Systems Manual.

WARNING

The MHRFD should always be test fired, following local agency procedures, before using live explosives. An MHRFD which has not been test fired may malfunction, resulting in serious bodily injury or death.

- Ensure the transmitter power is off by observing that the ON light-emitting diode (LED) is extinguished and the safe-arm key card is removed. The operator may elect to take the safe-arm key card downrange while preparing the receiver.
- While following all local agency setup procedures, secure detonator/cap by placing it in a hole in the ground or covering it with a sandbag. Ensure the detonator/cap or any tool being used is not in contact with explosive materials.

CAUTION

Protect the MHRFD from potential blast damage by distance, shielding, and cover. Units not adequately protected from blast may malfunction or fail completely.

At each receiver unit;

- Ensure the power is turned off. Rotate antenna into vertical position.
- Press and hold ON/OFF touch pad until the ON LED illuminates. Wait until the unit completes its self-diagnostic check.
- Attach the shock tube or electric wire from the detonator/cap
- Press the CHANNEL SELECT button until the channel ID LED indicates the desired channel ID.

- Start the receiver arming sequence by pressing and holding the ARM touch pad until the ARM LED begins to flash. Record the start time and start a stopwatch to determine when the safe separation period has elapsed (5 minutes). The transmitter gives no indication of when the safe separation period is over.
- The ARM status LED will begin flashing and will continue to do so for 5 minutes. This indicates that the unit is operating in the 5-minute safe separation period. **Ignore all radio link communications at this time.** The ARM status LED will stop blinking upon completion of the safe separation period. At any time before firing, the ARM touch pad may be pressed and held for at least 2 seconds to return the receiver unit to the arm condition, which starts a new 5-minute safe separation period.
- As soon as the arm sequence is started, attached the detonator/cap to the explosive charge according to agency procedures. Ensure all personnel are in safe positions before the expiration of the 5-minute safe separation period.

WARNING

Do not touch the MHRFD receiver after the explosive charge has been attached to the detonator/cap.

CAUTION

The MHRFD should not be relied on to fire properly if left in an armed state for more than ten hours. However, low batteries can only cause it to fail to a safe state.

At the transmitter unit;

- Ensure all personnel are at a safe distance from the detonation area.
- Rotate antenna into vertical position. Press and hold the POWER touch pad until the ON LED lights. Wait until the unit completes its self-diagnostic check.
- Press the CHANNEL SELECT touch pad until the LED indicator adjacent to the desired channel ID is on.
- Insert the safe-arm key card into the slot at the base of the transmitter. The FIRE LED will light.

When ready to fire, press and hold the fire touch pad on the transmitter until the FIRE LED flashes, indicating the fire command has been transmitted.

- When ready to fire, give three loud directional “Fire In The Holes”, wait for the FIRE LED to stop flashing before pressing and holding the FIRE touch pad again.

WARNING

In the event of a misfire, safe procedures must be followed. See Paragraph 7.0 of this SOP for misfire procedures.

3.8 DEMOLITION RANGE INSPECTION SCHEDULE

The demolition range inspection schedule outlined in Table 207-1 will be followed at sites where demolition operations are being conducted. This inspection shall be conducted by the UXOSO and will be documented in the Site Safety Log. If any deficiencies are noted, demolition operations shall be suspended and the deficiency reported to the SUXOS and DS. Once the deficiencies are corrected, demolition operations may be resumed.

Table 207-1: Demolition Range Inspection Schedule

Check List Item	Inspection Schedule
Site Vehicles	Weekly or Prior to Use
Explosive Carrier Vehicle	Weekly and Prior to Use
Range Access/Egress Route	Weekly or Prior to Use
Entrance Gate/Lock	Daily, Prior to Use and After Use
Storage Trailer/Magazine	Daily, Prior to Use and After Use
Fire Extinguishers	Monthly and Prior to Use
Personal Protective Equipment	Prior to Use
Circuit Testing Device	Prior to Use
Demolition Site	Prior to Use
Operating Equipment	Prior to Use
Hospital Route	Prior to Use

4.0 METEOROLOGICAL CONDITIONS

In order to control the effects of demolition operations and to make sure of the safety of site personnel, the following meteorological limitations and requirements shall apply to demolition operations:

- Demolition operations will not be conducted during electrical storms or thunderstorms within 10 miles
- No demolition operations shall be conducted if the surface wind speed is greater than 20 miles per hour.

- Demolition operations will not be conducted during periods of visibility of less than one mile caused by, but not limited to, dense fog, blowing snow, rain, sand or dust storms.
- Demolition shall not be carried out on extremely cloudy days that are defined as: overcast (more than 80% cloud cover) with a ceiling of less than 2,000 feet.
- Demolition operations will not be conducted during any atmospheric inversion condition (low or high altitude).
- Demolition operations will not be conducted during periods of local air quality advisories.
- Demolition operations will begin no sooner than 30 minutes after sunrise and will be completed no later than 30 minutes before sunset. Personnel performing demolition operations using a non-electric ignition system should be cognizant of the required wait time for misfires, as detailed in Section 7.2. The necessary wait time has the potential to extend operations past dark, if not initiated early enough.

5.0 PRE-DEMOLITION/DISPOSAL PROCEDURES

5.1 PRE-DEMO/DISPOSAL OPERATIONAL BRIEFING

The success of any operation is dependent upon a thorough brief, covering phases of the task, which is presented to affected personnel. The DS will brief personnel involved in range operations in the following areas:

- Type of MEC being destroyed.
- Type, placement and quantity of demolition material being used.
- Method of initiation (electric, non-electric or Non-EI).
- Means of transporting and packaging MEC.
- Route to the disposal site.
- Equipment being used (i.e., galvanometer, blasting machine, firing wire, etc.).
- Misfire procedures.
- Post shot cleanup of range.

5.2 PRE-DEMO/DISPOSAL SAFETY BRIEFING

The JV UXOSO will conduct a safety brief for personnel involved in range operations in the following areas:

- Care and handling of explosive materials.
- Personal hygiene.
- Two man rule and approved exceptions.
- Potential trip/fall hazards.
- Horse play on the range.
- Stay alert for any explosive hazards on the range.
- Location of emergency shelter (if available).

- Parking area for vehicles (vehicles must be positioned for immediate departure, with the keys in the ignition).
- Location of range emergency vehicle (keep engine running).
- Wind direction (to assess potential toxic fumes).
- Location of first aid kit and fire extinguisher.
- Route to nearest hospital or emergency aid station.
- Type of communications in event of an emergency.
- Storage location of demolition materials and MEC awaiting disposal.
- Demolition schedule.

5.3 TASK ASSIGNMENTS

Individuals with assigned tasks will report the completion of the task to the DS. The types of tasks that may be required are:

- Contact the local Police, Fire personnel, United States Coast Guard (USCG) and Federal Aviation Administration (FAA) as required.
- Contact hospital/emergency response personnel if applicable.
- Secure access roads to the range area.
- Visually check range for any unauthorized personnel.
- Check firing wire for continuity and shunt.
- Prepare designated pits as required.
- Check continuity of detonators.
- Check time/safety fuse and its burn rate.
- Designate a custodian of the blasting machine, fuse igniters, or Non-El initiator.
- Secure detonators in a safe location.
- Place MEC in pit and place charge in desired location.

5.4 PREPARING EXPLOSIVE CHARGE FOR INITIATION

To prepare the explosive charge for initiation, the procedures listed below will be followed:

- Make sure firing wire is shunted.
- Connect detonator to the firing wire.
- Isolate or insulate connections.
- Prime the demolition charge.
- Place the demolition charge on MEC.
- Depart to firing point (if using non electric firing system, obtain head count, pull igniters and depart to designated safe area).
- Obtain a head count.
- Give one-minute warning signal, using a bullhorn or siren, five minutes prior to detonation, and again at one minute prior to detonation.
- Check the firing circuit.
- Yell **"fire in the hole"** three times (or an equivalent warning) and take cover.

- If using electric firing system connect firing wires to blasting machine and initiate charge.
- Remove firing wires from blasting machine and shunt.
- Remain in designated safe area until DS announces **"All Clear"**. This will occur after a post-shot waiting period of 5-minutes and the DS has and inspected the pit(s).

6.0 POST DEMOLITION/DISPOSAL PROCEDURES

Do not approach a smoking hole or allow personnel out of the designated safe area until cleared to do so, and follow the below listed procedures:

- After the **"All Clear"** signal, check pit for low orders or kick outs.
- Conduct a magnetometer check of the pit and remove any large fragmentation.
- Back fill hole as necessary.
- Police up equipment.
- Notify police, fire, etc. that the operation is complete.

7.0 MISFIRE PROCEDURES

A thorough check of equipment, firing wire and detonators will prevent most misfires. However, if a misfire does occur, the procedures outlined below shall be followed.

7.1 ELECTRIC MISFIRES

To prevent electric misfires, one technician will be responsible for electrical wiring in the circuit. If a misfire does occur, it must be cleared with extreme caution, and the responsible technician will investigate and correct the situation, using the steps outlined below:

- Check firing line and blasting machine connections and make a second initiation attempt.
- If unsuccessful, disconnect and connect to another blasting machine (if available) and attempt to initiate charge.
- If unsuccessful, commence a 30-minute wait period.
- After the maximum delay predicted for any part of the shot has passed, the designated technician will proceed down range to inspect the firing system, and a safety observer must watch from a protected area.
- Disconnect and shunt the detonator wires, connect a new detonator to the firing circuit, check the replacement detonator for continuity, and prime the charge without disturbing the original detonator.
- Follow normal procedures for effecting initiation of the charge.

7.2 NON-ELECTRIC MISFIRES

Working on a non-electric misfire is the most hazardous of operations. Occasionally, despite painstaking efforts, a misfire will occur. Investigation and corrective action should be undertaken only by the technician that placed the charge, using the following procedure:

- If charge fails to detonate at the determined time, initiate a 60-minute wait period plus the time of the safety fuse, i.e., 6-minute safety fuse plus 60 minutes for a total of 66 minutes.
- After the wait period has expired, a designated technician will proceed down range to inspect the firing system. A safety observer must watch from a protected area.
- Prime the shot with a new non-electric firing system and install a new fuse igniter.
- Follow normal procedures for initiation of the charge.

7.3 NON-EL MISFIRE

The use of a shock tube for blast initiation can present misfires that require the following actions:

- If charge fails to detonate, it could be the result of the shock tube not firing. Visually inspect the shock tube, if it is not discolored (i.e., slightly black), it has not fired.
- If it has not fired, cut a one-foot piece off the end of the tube, re-insert the tube in the firing device and attempt to fire again.
- If the device still does not fire, wait 60 minutes and proceed down range to replace the shock tube per instructions outlined below.
- If the tube is slightly black, then a "Black Tube" misfire has occurred, and the shock tube will have to be replaced. When replacing the shock tube, be sure to remove the tube with the detonator in place. Without removing the detonator from the end of the tube, repackage the defective tube and return it to the supplier for credit.

7.4 DETONATING CORD MISFIRE

The JV uses det cord to tie in multiple demolition shots and to make sure that electric detonators are not buried. Since det cord initiation will be either electrical or non-electrical, the procedures presented in Paragraphs 7.1, 7.2, or 7.3, as appropriate to the type of detonator used, will be used to clear a det cord misfire. In addition, the following will be conducted:

- If there is no problem with the initiating system, wait the prescribed time and inspect the initiator to the cord connection to make sure it is properly connected. If it was a bad connection, simply attach a new initiator and follow the appropriate procedures in Paragraph 3.0.

- If the initiator detonated and the cord did not, inspect the cord to make sure it is det cord and not time fuze. Also, check to make sure there is pentaerythritol tetranitrate (PETN) in the cord at the connection to the initiator.
- It may be necessary to uncover the det cord and replace it. This must be accomplished carefully to make sure that the demolition charge and the MEC item are not disturbed.

7.5 PERFORATOR MISFIRE

The use of perforators is considerably safer than the use of many other demolition materials. If the perforator is not initiated properly, it could malfunction. Since the perforator is covered with tamping material, det cord is used as the initiator. Therefore, in the event of a misfire, the procedures presented in paragraph 7.4 will be followed, along with the items presented below.

- If everything went but the perforator, one of four things has occurred:
  1. Det cord grain size was insufficient to initiate the perforator.
  2. The det cord was dislodged from the perforator when placing tamping materials.
  3. The perforator was defective.
  4. The perforator was moved during the placement of tamping materials.
- Check to make sure the grain size of the det cord is sufficient, with 80 grain size or greater being the recommended size.
- If the det cord connection to the perforator was the problem, make sure that the next connection is secure (use duct tape if necessary).
- If it is evident that the perforator was moved, make sure it is properly secured for the next shot.
- If cord size and connection are sufficient, replace the perforator. Position the defective Perforator to be destroyed with the demolition shot and prevent kickout.

8.0 RECORD KEEPING REQUIREMENT

To document the demolition operations procedures and the completeness of the demolition of MEC, the following record keeping requirements shall be met:

- The client or JV (as directed) will obtain and maintain required permits.
- The DS will make sure of the accurate completion of the logs, and the SUXOS and UXO Quality Control Specialist (UXOQCS) will monitor the entries in the log for completeness, accuracy and compliance with meteorological conditions.
- The DS shall enter the appropriate data on the Demolition Shot Record (Form-

205B) to reflect the MEC destroyed, and shall complete the appropriate information on the Explosives Accountability Record/Magazine Data Card (DD Form 3020-R) that indicates the demolition materials used to destroy the MEC.

- The quantities of MEC recovered must also be the quantities of MEC destroyed or disposed.
- The JV will retain a permanent file of demolition records, including permits, magazine data cards, training and inspection records, waste manifests if applicable, and operating logs.
- Copies of Alcohol, Tobacco, and Firearms (ATF) License and any state or local permits must be on hand.

9.0 SAFETY AND PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

The following safety measures and personal protective equipment shall be used in preventing or reducing exposure to the hazards associated with MEC demolition/disposal operations. These requirements will be implemented unless superseded by site specific requirements stated in the Site Safety and Health Plan (SSHP)/Accident Prevention Plan (APP).

1. Hard hats are required only when working around heavy equipment or when an overhead or head impact hazards exist.
2. Steel toe/shank boots will not be worn during surface/subsurface clearances using geophysical instruments in the location of anomalies unless a serious toe hazard exists, whereupon a fiber safety toe will be used.
3. American National Standards Institute (ANSI) Z87 approved safety glasses will be required an eye hazard exists, for example when working around flying dirt/debris, using hand tools, etc. Safety glasses will provide protection from impact hazards, and, if necessary, ultraviolet (UV) radiation (i.e., sunlight).
4. Positive means shall be required to secure the personal protective equipment (PPE) and prevent it from falling and causing an accidental detonation.

10.0 REGULATORY REFERENCES

Applicable sections and paragraphs in the documents listed below will be used as references for the conduct of MEC demolition/disposal operations:

- Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1926 Construction Standards (notably 29 CFR 1926 Subpart U, Blasting and the Use of Explosives).
- Department of Defense (DoD) 6055.9-M, DoD Ammunition and Explosive Safety Standards

- American conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®) NIOSH/OSHA/USCG/EPA, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. (DHHS (NIOSH) Publication No. 85-115).
- Applicable sections of Department of Transportation (DOT), 49 CFR Parts 100 to 199.
- Bureau of Alcohol Tobacco Firearms and Explosives (BATFE) 5400.7, Alcohol Tobacco and Firearms Explosives Laws and Regulations.
- DoD 4145.26-M, DoD Contractor's Safety Manual for Ammunition and Explosives
- DDESB Technical Paper (TP) 16, Methodologies for Calculating Primary Fragment Characteristics
- DDESB TP 18, Qualifications for UXO Technicians and Personnel
- EOD TM 60A-1-1-31 Explosive Ordnance Disposal Procedures
- DA-Pam 385-64, Ammunition and Explosives Safety Standards
- USACE Engineering Regulation (ER) 385-1-92, Safety and Occupational Health Requirements for Hazardous, Toxic and Radioactive Waste (HTRW) Activities
- USACE EM 385-1-97, Explosive Safety and Health Requirements Manual
- USACE Engineering Pamphlet (EP) 1110-1-18, Ordnance and Explosives Response
- USACE EM 200-1-15, Technical Guidance for Military Munitions Response Actions
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-95, Safety and Health Requirements for MEC Operations
- The JV Corporate Environmental Safety and Health Plan (CESHP), Quality Management System (QMS) and SOP's (these documents will be on site and available to site personnel during the project).

11.0 ATTACHMENTS

Table 207-2: Minimum Safe Distance from Transmitter Antennas
Table 207-3: Minimum Safe Separation Formulas

TABLE 207-2: MINIMUM SAFE DISTANCE FROM TRANSMITTER ANTENNAS

Average or peak transmitter power in watts	Minimum distance to transmitter Meters	Minimum distance to transmitter Feet
0 - 30	30	98.4
31 - 50	50	164.1
51 - 100	110	360
101 - 250	160	525
251 - 500	230	755
501 - 1,000	305	1,000
1,000 - 3,000	480	1,575
3,001 - 5,000	610	2,001
5,001 - 20,000	915	3,002
20,001 - 50,000	1,530	5,020
50,001 - 100,000	3,050	10,007
100,001 - 400,000	6,100	20,014
400,001 - 1,600,000	12,200	40,028
1,600,001 - 6,400,000	24,400	80,056

Notes:

1. When the transmission is a pulsed or pulsed continuous wave type and its pulse width is less than 10 microseconds, the power column indicates average power.
2. For all other transmissions, including those with pulse widths greater than 10 microseconds, the power column indicates peak power.

Source: DA PAM 385-6

TABLE 207-3: MINIMUM SAFE SEPARATION FORMULAS

UN-SHIELDED MUNITIONS		SHIELDED MUNITIONS	
UP TO 2.3 KHz	$D = 0.093\sqrt{PG}$	UP TO 73 KHz	$D = 0.093\sqrt{PG}$
2.3 KHz to 450 KHz	$D = 39.7F\sqrt{PG}$	73 KHz to 450 KHz	$D = 1.26F\sqrt{PG}$
450 KHz to 400 MHz	$D = 18\sqrt{PG}$	450 KHz to 400 MHz	$D = 0.6\sqrt{PG}$
400 MHz to 75,000 MHz	$D = \frac{7137}{F}\sqrt{PG}$	400 MHz to 2,400 MHz	$D = \frac{226}{F}\sqrt{PG}$
ABOVE 75,000MHz	$D = 0.093\sqrt{PG}$	ABOVE 2,400 MHz	$D = 0.093\sqrt{PG}$

Notes:
1. Variables:
2. D=Safe separation distance to transmitter in feet.
3. P=Output power to transmitter in Watts.
4. G=Numerical gain of transmitter antenna.
5. F=Frequency in MHz.

TABLE ASSUMES:
1. NO–FIRE CURRENT=10 mA.
2. SAFETY FACTOR=10dB or 3.61 (numerical).
3. EED's LEADS=Tuned to match the transmitter's frequency.
4. SHIELDING=If metallic, it provides a minimum or 30 dB or 32 times (numerical) of shielding. Non- metal packs provide no shielding.
5. At no time, should personnel or munitions be exposed to more than 200 volts/meter (rms).

Source: DA PAM 385-64

U.S. Department of Justice
Bureau of Alcohol, Tobacco, Firearms and Explosives

Federal Explosives License/Permit
(18 U.S.C. Chapter 40)

In accordance with the provisions of Title XI, Organized Crime Control Act of 1970, and the regulations issued thereunder (27 CFR Part 555), you may engage in the activity specified in this license or permit within the limitations of Chapter 40, Title 18, United States Code and the regulations issued thereunder, until the expiration date shown. **THIS LICENSE IS NOT TRANSFERABLE UNDER 27 CFR 555.53.** See "WARNINGS" and "NOTICES" on reverse.

Direct ATF Correspondence To	ATF - Chief, FELC 244 Needy Road Martinsburg, WV 25405-9431	License/Permit Number	**8-MD-510-33-6A-00342**
Chief, Federal Explosives Licensing Center (FELC)	Christopher R. Reeves	Expiration Date	**January 1, 2016**

Name
ARCADIS US, INC

Premises Address (Changes? Notify the FELC at least 10 days before the move.)
300 EAST LOMBARD STREET SUITE 1510
BALTIMORE, MD 21202-

Type of License or Permit
33-USER OF EXPLOSIVES

Purchasing Certification Statement
The licensee or permittee named above shall use a copy of this license or permit to assist a transferor of explosives to verify the identity and the licensed status of the licensee or permittee as provided by 27 CFR Part 555. The signature on each copy must be an original signature. A faxed, scanned or e-mailed copy of the license or permit with a signature intended to be an original signature is acceptable. The signature must be that of the Federal Explosives Licensee (FEL) or a responsible person of the FEL. I certify that this is a true copy of a license or permit issued to the licensee or permittee named above to engage in the business or operations specified above under "Type of License or Permit."

Mailing Address (Changes? Notify the FELC of any changes.)
ARCADIS US, INC
300 EAST LOMBARD STREET SUITE 1510
BALTIMORE, MD 21202-

Heather Polinsky — Licensee/Permittee Responsible Person Signature
Senior Vice President — Position/Title
Heather POLINSKY — Printed Name
12/14/12 — Date

Previous Edition is Obsolete ARCADIS US, INC:300 EAST LOMBARD STREET SUITE 1510:21202:8-MD-510-33-6A-00342:January 1, 2016:33-USER OF EXPLOSIVES

ATF Form 5400.14/5400.15 Part I
Revised October 2011

Federal Explosives License (FEL) Customer Service Information

Federal Explosives Licensing Center (FELC)
244 Needy Road
Martinsburg, WV 25405-9431

Toll-free Telephone Number: (877) 283-3352
Fax Number: (304) 616-4401
E-mail: FELC@atf.gov

ATF Homepage: www.atf.gov

Change of Address *(27 CFR 555.54(a)(1))*. Licensees or permittees may during the term of their current license or permit remove their business or operations to a new location at which they intend regularly to carry on such business or operations. The licensee or permittee is required to give notification of the new location of the business or operations not less than 10 days prior to such removal with the Chief, Federal Explosives Licensing Center. The license or permit will be valid for the remainder of the term of the original license or permit. **(The Chief, FELC, shall, if the licensee or permittee is not qualified, refer the request for amended license or permit to the Director of Industry Operations for denial in accordance with § 555.54.)**

Right of Succession *(27 CFR 555.59)*. (a) Certain persons other than the licensee or permittee may secure the right to carry on the same explosive materials business or operations at the same address shown on, and for the remainder of the term of, a current license or permit. Such persons are: (1) The surviving spouse or child, or executor, administrator, or other legal representative of a deceased licensee or permittee; and (2) A receiver or trustee in bankruptcy, or an assignee for benefit of creditors. (b) In order to secure the right provided by this section, the person or persons continuing the business or operations shall furnish the license or permit for for that business or operations for endorsement of such succession to the Chief, FELC, within 30 days from the date on which the successor begins to carry on the business or operations.

(Continued on reverse side)

Cut Here ✂

Federal Explosives License/Permit (FEL) Information Card

License/Permit Name: **ARCADIS US, INC**

Business Name:

License/Permit Number: **8-MD-510-33-6A-00342**

License/Permit Type: **33-USER OF EXPLOSIVES**

Expiration: **January 1, 2016**

Please Note: Not Valid for the Sale or Other Disposition of Explosives.

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide the minimum safety and health requirements and procedures applicable to the conduct of operations involving the use of on and off road motor vehicles.

2.0 PROCEDURE

2.1 GENERAL REQUIREMENTS

"Motor Vehicle" shall mean any vehicle propelled by a self contained power unit, or equipment designed for use on paved roads. All-purpose utility vehicle (APUV) shall mean any four wheeled or greater vehicle propelled by a self contained power unit designed for use off road. Every person regularly or occasionally operating a motor vehicle shall possess a valid permit for the equipment being operated. No motor vehicle shall be placed in service until it has been inspected and found to be in safe operating condition.

All motor vehicles shall be inspected and maintained in accordance with (IAW) this program. Motor vehicles being used shall be checked at the beginning of each day to assure that the parts, equipment, and accessories are in safe operating condition and free of apparent damage that could cause failure while in use. The part, equipment and accessories of concern include service brakes, including trailer brake connections; parking system (hand brake); emergency stopping system (brakes); tires; horn; steering mechanism; coupling devices; seat belts; operating controls; and safety devices. These requirements also apply to equipment such as lights, reflectors, windshield wipers, defrosters, and fire extinguishers where such equipment is necessary. Vehicles not meeting safe operating conditions shall be removed from service, repaired or replaced, and re-inspected before being placed back in service.

All motor vehicles operated between sunset and sunrise shall have the following lights:

1. Two headlights, one on each side.
2. At least one red taillight and one red or amber stop light on each side.
3. Directional signal lights both front and rear.

All motor vehicles, except APUV's, trailers or semitrailers having a gross weight of 5,000 pounds or less, shall be equipped with service brakes and manually operated parking brakes. Service and parking brakes shall be adequate to control the movement of, to stop, and to hold the vehicle under various conditions of service. Service brakes on trailers and semitrailers shall be controlled from the driver's seat of the prime mover.

Braking systems on every motor vehicle shall be so designed as to be in approximate synchronization on all wheels and develop the required braking effort on the rearmost wheels first unless the vehicle is equipped with an "Anti-lock Braking System" (ABS). The design shall also provide for application of the brakes by the driver of the prime mover from the cab. Exceptions to this are vehicles in tow by an approved tow bar hitch.

Every motor vehicle shall be equipped with the following equipment:

1. First aid kit and fire extinguisher (periodically ensure that the first aid kit is fully stocked and that the fire extinguisher has been inspected and is within its inspection period);
2. A working speedometer;
3. A fuel gauge;
4. An audible warning device in operating condition;
5. A windshield equipped with an adequate powered windshield wiper;
6. An operable defrosting and defogging device;
7. And an adequate rear view mirror or mirrors;
8. Cabs, cab shields, and other protection shall be provided to protect the driver from the hazards of falling or shifting materials;
9. Non-slip surfaces shall be provided on steps;
10. Glass in windshields, windows, and doors shall be safety glass;
11. Cracked or broken glass shall be replaced;
12. All towing devices shall be structurally adequate for the weight drawn and be properly mounted; and
13. All motor vehicles shall be equipped with a power operated starting device.

All trailers will be equipped as follows:

1. A locking device or double safety system, shall be provided on every fifth wheel mechanism and tow bar arrangement which will prevent the accidental separation of towed and towing vehicles; and
2. Every trailer shall be coupled with safety chains or cables to the towing vehicle. Such chain or cable shall prevent the separation of the vehicles in the event of failure of the tow bar.

When operated on public highways, buses, trucks, and combinations of vehicles with a carrying capacity of 12 tons or greater shall be equipped with emergency equipment required by state laws but not less than those listed below:

1. One red flag not less than 12 inches square and 3 reflective markers which shall be available for immediate use in case of emergency stops.
2. Two wheel chocks for each vehicle or each unit of a combination of vehicles.

3. At least one fire extinguisher rated at 20-B:C units, with at least two such rated fire extinguishers being required for flammable cargos; including munitions and explosives of concern (MEC)/munitions debris (MD).
4. Vehicle exhaust shall be controlled so that it will present no hazards to the operator, passengers, or other personnel.
5. Records of tests and safety inspections shall be maintained at the site and shall be available on request.
6. All rubber tired motor vehicles shall be equipped with fenders. Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

2.2 WEEKLY INSPECTIONS

On a weekly basis, a thorough inspection shall be conducted using the JV's Vehicle Inspection Report (Form-507) and turned into site management for forwarding to the JV equipment manager. An exception applies to explosive carriers, which must have a documented inspection prior to each explosives transport (see JV SOP-203 Transportation of Explosives).

2.3 DRIVER AUTHORIZATION AND QUALIFICATIONS

Authorization to use a JV owned or rented vehicle either for company business or for personal use off the clock and off the job site will only be given if the employee (inclusive of subcontractors) has been certified as an Approved JV Driver. To be an Approved JV Driver, personnel will be required to sign the Approved JV Driver Form and provide a copy of their current driver's license and personal vehicle insurance. This also includes use of personal vehicle for company business, or renting a vehicle while traveling on company business. An unacceptable Motor Vehicle Report (MVR) has three or more moving violations, and/or a Driving Under the Influence/Driving while Intoxicated (DUI/DWI) conviction in the last three years. It is the employee's responsibility to renew the driver's license and insurance before expiration, and to provide a copy of the renewal to the Site Manager/SUXOS who will forward it to Human Resources. Any new DUI/DWI convictions or suspension of driver's license is to be reported immediately to the Site Manager/SUXOS and employee will stop driving company vehicles until an acceptable MVR is obtained. The JV has the authority to obtain an MVR at any time to evaluate the employee's fitness to drive. Employees and subcontractors will not drive for the JV until notified that they are an Approved JV Driver.

2.4 SUBCONTRACTOR MOTOR VEHICLE SAFETY REQUIREMENTS

All subcontractors wishing to drive a JV owned or rented vehicle must comply with the authorization process described in Section 2.2 of this SOP to become an Approved JV Driver. As an Approved JV Driver all subcontractors will be required to comply with this

SOP and any applicable site specific motor vehicle safety requirements which may not be detailed herein.

2.5 VEHICLE SELECTION

Selection and use of a JV owned or rented vehicle shall be based on the ability of the vehicle to safely satisfy the required need. Variables such a seating capacity, hauling capacity, towing capacity, etc. shall be considered and a vehicle appropriate for the task at hand shall be selected.

2.6 DRIVER TRAINING

Driver refresher training shall be conducted at the site level and will consist of one or more daily safety tailgate briefings pertaining to defensive driving and/or best practices. Additional tailgate briefings themed around safe vehicle operation may be performed as appropriate, to be determined by the Site Safety and Health Officer (SSHO).

2.7 VEHICLE OPERATING STANDARDS

No motor vehicle shall be driven at a speed greater than the posted speed limit, with due regard for weather, traffic, intersections, width and character of the roadway, type of motor vehicle, and any other existing condition. The operator must, at all times, and under all conditions, have the vehicle under such control as to be able to bring it to a complete stop within the assured clear distance ahead. To accomplish this, the operator shall follow the safe operating rules presented below:

1. Headlights shall be switched to low beam when approaching other vehicles.
2. No motor vehicle shall be driven on a downgrade with gears in neutral or clutch disengaged.
3. Every motor vehicle, upon approaching an unguarded railroad crossing or drawbridge, shall be driven at such a speed as to permit stopping before reaching the nearest track or the edge of the draw and shall proceed only if the course is clear.
4. No motor vehicle shall be stopped, parked, or left standing on any road or adjacent thereto or in any area in such a manner as to endanger the vehicle, other vehicles, equipment, or personnel using or passing that road or area.
5. No motor vehicle shall be left unattended until the motor has been shut off, the key removed (unless site regulations prohibit), the parking brake set, and the gear engaged in low, reverse, or park.
6. If stopped on a hill or grade, front wheels shall be turned or hooked into the curb or the wheels securely chocked.
7. Personnel shall not be permitted to get between a towed and towing vehicle except when hooking or unhooking.
8. No motor vehicle or combination of vehicles, hauling unusually heavy loads or equipment shall be moved until the driver has been provided with required

permits, the correct weights of the vehicles and load, and a designated route to be followed.

9. When backing or maneuvering, operators will take the applicable precautions and whenever possible, use a backing guide. The guide should use hand signals that both are familiar with. When backing a truck without a guide, first be aware of the surrounding area into which the truck is to be backed. Proceed slowly with caution.
10. Operators of motor vehicles transporting personnel, explosives, flammable, or toxic substances shall stop at railroad crossings or drawbridges and shall not proceed until the course is determined to be clear. A stop shall not be required at a crossing within a business or residential district; protected by a watch person, traffic officer or by a traffic signal giving a positive indication to approaching vehicles.
11. When a bus, truck, or truck/trailer combination is disabled or parked on the traveled portion of a highway or the shoulder adjacent thereto, red flags shall be displayed during the daytime and reflector, flares, or electric lights at night. An exception may be made in residential or business sections or municipalities.
12. The principles of defensive driving shall be practiced.
13. Seat belts will be installed and worn per 49 CFR 571 (Department of Transportation). Seat belts must be used by all occupants of a vehicle, including those sitting in the rear seats.
14. It is prohibited for individuals to ride in the open bed of a pickup truck, even for short distances.
15. If the windshield wipers are in use due to rain, headlights will be activated.
16. All vehicles, including those of visitors and guests, shall back-in (reverse) park only at all JV work locations, including offices. The exception to this rule is for parallel parking, angular parking, or where back-in parking is specifically prohibited.
17. Continually check your surroundings while driving and when parking. Look out for obstructions, low-hanging trees and branches, wires or poles, pot holes, muddy or water-filled areas, or other hazards that may damage the vehicle or tires. Be aware of and try to get behind rash drivers. Keep a safe distance from the vehicle in front of you. Follow the 2-second rule.
18. Adjust the mirrors correctly to minimize the blind areas. Remember that side and rear-view mirrors do not give you a full 180° view of the rear of the vehicle.
19. Driving under the influence of drugs or alcohol is strictly prohibited. Employees may be asked to take a drug and alcohol test if suspected of DUI. If the results are positive, the employee will be immediately disciplined, including and up to termination of employment.

2.8 FATIGUE

Avoid driving when tired or sleepy. If using prescription drugs that cause drowsiness, avoid driving. If on the road and you start feeling sleepy, pull off to a safe spot, lock the car and take a brief nap.

2.9 USE OF CELL PHONES

Hand-held cell phones shall not be used while driving JV or rented vehicles, or in personal vehicles while on company time. The use of phones connected to earplugs or to blue tooth devices, while it is not encouraged, is permitted, as long as they are not held in the hand while driving. Texting while driving is strictly prohibited. If cell phones are to be used in an emergency, the vehicle must be brought to a complete stop in a safe location, before the phone is used.

NOTE: Certain States have specific prohibitions for cell phone use. These laws must be obeyed.

2.10 DRIVER OBSERVATION

All Approved JV Drivers will be subject to peer observation and feedback pertaining to their compliance with the standards contained in this SOP. Performance of driver observation and reporting of at-risk behaviors to appropriate supervisory personnel will be the responsibility of all JV and sub-contracted personnel. Violations of this SOP or observations of at-risk behaviors shall be relayed from site supervisory personnel to the Corporate Environmental Safety and Health Manager (CESHM) for determination of the corrective action to be applied.

2.11 MOTOR VEHICLE ACCIDENTS AND DAMAGE

In the event of an accident:

- Stay calm.
- Make sure you and your passengers are OK.
    - Move as far off the roadway as possible, but stay at the scene of the accident.
    - Warn oncoming traffic by activating your hazard warning lights and/or setting flares.
- Call the police.
    - Call 911 or the appropriate emergency number to report the accident.
- Follow the JV Incident Reporting Procedure to report the accident to the JV.
- Do not admit fault.
    - Do not discuss the car accident with anyone other than the police and the JV site manager or safety representative.
- Exchange vital information with the other driver involved in the car accident.

- Write down the name, address, phone number and license numbers for all drivers and witnesses, particularly those who were not riding in a vehicle involved in the accident.
- Ask for the insurance companies and policy numbers for drivers involved in the car accident.

Employees who are involved in preventable (at fault) accidents during working hours will receive corrective action including, but not limited to: driver training; defensive driving course, payment of the company deductible, temporary or permanent removal from approved JV driver list, or termination of employment.

Damage caused while driving a company vehicle for personal use off the clock and off the job site will be the personal responsibility of the employee. The JV has the authority to make an insurance claim against the employee's personal vehicle insurance to pay for damages. Any damages not paid for by insurance will be the responsibility of the employee and either paid directly or through payments deducted from the employee's paycheck.

2.12 TRANSPORTATION OF PERSONNEL

The number of passengers in passenger type vehicles shall not exceed the number of seats equipped with approved seat belts. Trucks used to transport personnel shall be equipped with a seating arrangement securely anchored, a rear gate, guardrail and steps or ladders, for mounting and dismounting. The beds of trucks which are not equipped with appropriate safety devices as described in this paragraph, will not be used to transport personnel unless absolutely necessary and never on a public highway, unless it is an emergency. Additional personnel transportation requirements are listed below:

1. All tools and equipment shall be guarded, stowed, and secured when transported with personnel.
2. No person will be permitted to ride with arms or legs outside of truck body, in a standing position on the body, or on running boards, or seated on side fenders, cabs, cab shields, rear of truck, or on the load.
3. All motor vehicles transporting personnel during cold or inclement weather shall be enclosed.
4. No explosives, flammable materials (except normal fuel supply), or toxic substances shall be transported in vehicles being used to transport personnel.
5. No motor vehicle transporting personnel shall be moved until the driver has ascertained that persons in the vehicle are seated and the guardrail and rear gate are in place or doors closed.
6. Getting on or off any vehicle while it is in motion is prohibited.

2.13 FUELING

All motor vehicles shall be shut off during fueling operations, and no smoking or open flames will be permitted within 50 feet of fueling operations. Care should be taken not to spill fuel, and only that fuel recommended by the manufacturer shall be used. During fueling where there is a potential for fuel contact with the skin, especially during cold weather, personnel will wear protective gloves as specified in the SSHP.

2.14 LOADING

Drivers of trucks and similar vehicles shall leave the cab if the cab of the vehicle being loaded is exposed to danger from suspended or overhead loading operations, unless the cab is adequately protected. No motor vehicle shall be loaded so as to obscure the driver's view ahead or to either side or to interfere with the safe operation of such vehicle. Motor vehicles carrying loads which project more than 4 feet beyond the rear of the vehicle shall carry a red light at or near the end of the projection at night or when atmospheric conditions restrict visibility. During daylight periods or other non-restricted conditions a red flag not less than 12 inches square shall be used. The load shall be distributed, chocked, tied down, or secured.

2.15 DRIVING IN BAD WEATHER

Bad weather creates hazardous driving conditions. Slow down and drive only at speeds at which you feel that you have complete control over the vehicle. Additionally, take the following steps (as applicable):

- In fog, drive with your hazard lights on. Keep your headlights on at low beam. Do not use your high beams in foggy weather.
- During rains slow down. Your vehicle is prone to hydroplaning and may skid across the street or highway.
- Do not use your cruise control when it is raining or the roadway is wet.
- During heavy rains be aware of flooding. Low lying areas may build up deep pools of water that may flood the vehicle. If following behind a vehicle see how far up the water rises in that vehicle before proceeding further. Depending on the vehicle, if the water appears to be too high, stop and back out if it is safe to do so.
- Do not drive through flowing water. An average automobile can be swept away by just 10 inches of flowing water.
- If possible, do not park in a low lying spot as rising water may soon flood the vehicle.
- If the vehicles stalls in rising water, immediately roll down the windows and abandon the vehicle for higher ground.
- In snow and icy conditions, be aware of skidding and sliding. Be aware of ice build up on bridges and over passes.
- If stuck in a vehicle, immediately call 911.

When driving in bad weather conditions, the safest thing to do is to pull off to a safe spot on the side of the road and wait it out.

2.16 DRIVING AT NIGHT

Remember that visibility is greatly reduced at night. Slow down and increase the distance between you and the vehicle ahead of you. Do not over-ride your headlights. You must be able to safely stop within the distance illuminated by your headlights. Do not drive if sleepy or drowsy. If driving below the speed limit, keep your hazard lights on. Be aware that older drivers have more difficulty seeing clearly at night.

2.17 ALL TERRAIN VEHICLES/ UTILITY VEHICLES

During the operation of All-terrain Vehicles (ATVs) and Utility Vehicles (UTVs) every operator shall possess a valid state driver's license and have completed, as a minimum, an on-site training course prior to operation of the vehicle (IAW EM 385-1-1 Section 18). The operation of ATVs/UTVs shall be in strict compliance with the requirements stated in EM 385-1-1 Section 18.

3.0 REFERENCES

The following Occupational Safety and Health Administration (OSHA) standards directly apply to the conduct of operations associated with the SOP. In the event other hazards are associated with the conduct of this SOP, consultation of other SOPs and regulatory references may be needed. Additionally, this SOP has been designed to meet the U.S. Army Corps of Engineers (USACE) requirements outlined below.

- Applicable sections of OSHA Construction Industry Standard 29 CFR Part 1926.601;
- Applicable sections of Department of Transportation 49 CFR Part 100-199 and 571; and
- USACE EM 385-1-1, Section 18.

4.0 ATTACHMENTS

No attachments are associated with this SOP.

1.0 PURPOSE

This Standard Operating Procedure (SOP) establishes safety practices, means, methods and operations for tree felling, wood chipping, vegetation and brush clearing.

2.0 DEFINITIONS

Backcut (felling cut) - The final cut in a felling operation.

Ballistic nylon - A nylon fabric of high tensile properties designed to provide protection from lacerations.

Buck - To cut a felled tree into logs.

Butt - The bottom of the felled part of a tree.

Clearance – Clearing within the work area includes removing and disposing of trees, brush and vegetation.

Designated person - An employee who has the requisite knowledge, training and experience to perform specific duties.

Domino felling - The partial cutting of multiple trees which are left standing and then pushed over with a pusher tree.

Facecut – The cut in the tree that is located on the side of the tree that corresponds to the designated direction of the tree when it falls. The facecut consists of two cuts that remove a notch from the tree and is cut perpendicular to the direction the tree will fall. The facecut is cut into the tree no more than 1/3rd the diameter of the tree.

Fell (fall) - To cut down trees.

Feller (faller) - An employee who fells trees.

Guarded - Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable enclosures, covers, casings, shields, troughs, railings, screens, mats, or platforms, or by location, to prevent injury

Grubbing – Grubbing is removing from the ground and disposing of stumps, roots and stubs, brush and debris.

Landing - Any place where logs are laid after being yarded, and before transport from the work site.

Limbing - To cut branches off felled trees.

Lodged tree (hung tree) - A tree leaning against another tree or object which prevents it from falling to the ground.

Log - A segment sawed or split from a felled tree, such as, but not limited to, a section, bolt, or tree length.

Logging - For this SOP, logging is defined as any operation conducted on site that involves the use of chain saws for tree felling, limbing or sizing.

Snag - Any standing dead tree or portion thereof.

Spring pole - A tree, segment of a tree, limb, or sapling which is under stress or tension due to the pressure or weight of another object.

Undercut – A notch in a tree to guide the direction of the tree and to prevent splitting or kickback.

3.0 PROCEDURES

3.1 ENVIRONMENTAL CONDITIONS

All vegetation and tree removal work shall terminate and each employee shall move to a place of safety when environmental conditions, such as but not limited to, electrical storms, strong winds that may affect the fall of a tree, heavy rain or snow, extreme cold, dense fog, fires, mudslides, and darkness, create a hazard for the employee in the performance of the job. The Site Safety and Health Officer (SSHO), in conjunction with the Site Supervisor (SS) will determine both the time to halt operations and the time to resume operations.

3.2 WORK AREAS AND PERSONNEL SEPARATION

3.2.1 General Requirements

The requirements outlined in this SOP are the minimum distances and additional distance between personnel and equipment zones may be required due to varying site conditions. Site-specific separation distances that vary from those discussed in this SOP will be presented in the Site Safety and Health Plan (SSHP) or Accident Prevention Plan (APP). The buddy system will be used anytime personnel are involved in vegetation and tree removal procedures. Each employee involved with these operations shall work in a position or location that is within visual or audible contact with another employee.

3.2.2 Personnel Separation Using Fuel-powered Brush Cutters

Individuals conducting brush cutting and removal with fuel-powered brush cutters will be spaced at least 50 feet apart while the brush cutters are in operation. This restriction assumes that the operators are properly attired in personal protective equipment (PPE). Greater distances may be required if specified by the manufacturer in the owner's manual.

3.2.3 Personnel Separation for Tree Felling

Work areas shall be assigned so that trees cannot fall into an adjacent occupied work area. If multiple felling personnel are working adjacent to each other, the distance between adjacent occupied work areas shall be at least two times the length of the tree being felled. The distance between adjacent occupied work areas shall reflect the degree of slope, the density of the growth, the height of the trees, the soil structure and other hazards reasonably anticipated at that work site. A distance of greater than two tree lengths shall be maintained between adjacent occupied work areas on any slope where rolling or sliding of trees or logs is reasonably foreseeable.

3.3 GENERAL EQUIPMENT OPERATIONAL PROCEDURES

3.3.1 Chain Saw Operation

Each chain saw used on-site shall be equipped with a functional chain brake. Each chain shall also be equipped with a protective device that minimizes chain-saw kickback. No chain-saw kickback device shall be removed or otherwise disabled. Additionally the procedures listed below will be followed during chain saw operations.

1. Chainsaw operators are required to be trained in the operation, inspection and maintenance of equipment.
2. Each gasoline-powered chain saw shall be equipped with a continuous pressure throttle control system that will stop the chain when pressure on the throttle is released.
3. The chain saw shall be operated and adjusted in accordance with the manufacturer's instructions.
4. The chain saw shall be fueled at least 20 feet from any open flame or other source of ignition.
5. DO NOT fuel if the engine is hot. Allow the engine to cool down for 10 minutes before refueling.
6. The chain saw shall be started at least 20 feet from the fueling area.
7. The chain saw should be started on the ground or where the saw is firmly supported. This may include the use of plywood or other protective measure to ensure the chain does not contact the ground. Drop starting a chain saw is prohibited.
8. The chain saw should be controlled with two hands during saw operations. Exceptions to this include the minimal time needed to adjust the throttle or reach for and activate the kill switch.

9. The manufacturer's recommendations for chain saw use will be followed during chain saw operations.
10. The chain saw shall be carried in a manner that will prevent operator contact with the chain saw bar or chain.
11. Before the feller starts the retreat when a tree starts to fall, the chain saw shall be either immediately shut off and placed on the ground, or the throttle initially released and the saw carried out of the area (but no more than 50 feet) until the saw can be turned off and set down safely.
12. The chain saw shall be shut down whenever a saw is carried further than 50 feet. The chain saw shall be shut down when carried for less than 50 feet if there are any conditions that could cause the operator to stumble, slip or fall (i.e., obstructed terrain, slippery surfaces, dense underbrush, etc.).
13. Ear plugs and/or ear muffs required for Chainsaw operation and other high noise activities will be used as deemed necessary by the SSHO.

3.3.2 Gas-powered Brush Cutter/Trimmer Operation

Gas-powered brush cutters/trimmers will be used in accordance with the manufacturer's recommendations as specified in the Owner Manual. Brush cutters/trimmers will be equipped with a kill-switch and personnel will be familiar with the procedure for using the equipment controls and the kill-switch. Additionally, field personnel will follow the procedures listed below.

1. Brush cutter/trimmer operators are required to be trained in the operation, inspection and maintenance of equipment they will be using for the given task.
2. Read the operators manual prior to operating the trimmer.
3. Never allow untrained personnel to operate the trimmer.
4. Make sure the muffler is in good condition. In dry weather, use a fire-safe muffler.
5. Ensure that shields and other guards are in place and working properly. DO NOT remove or disable guards or other safety devices.
6. Use proper fuel mixture with the manufacturer's recommended two-stroke oil mixed to the manufacturer's recommendations.
7. Check the cutting blades prior to each use for cracks, missing teeth, and overall condition. Replace bent, warped, damaged or dull blade.
8. Do not overfill the fuel tank and allow fuel to leak onto muffler or hot engine.
9. DO NOT fuel if the engine is hot. Allow the engine to cool down for 10 minutes before refueling.
10. Maintain a safety zone of at least 50 feet (100 foot radius) to avoid injury from thrown objects.
11. Stop operations immediately if approached.
12. The trimmer should be started on the ground or where the unit is firmly supported in an open area.

13. The trimmer should be controlled with two hands during operations. Exceptions to this include the minimal time needed to adjust the throttle or reach for and activate the kill switch.
14. Hold the unit with both hands, plant feet firmly.
15. Keep the trimmer head below waist level.
16. Always stand on the proper side of the trimmer while cutting. On a curved shaft trimmer, the line head rotation is clockwise (cut on the left side.) On a straight shaft trimmer, the line head rotation is counterclockwise (cut on the right side).
17. Bring the engine to operating speed before starting vegetation cutting.
18. Do not operate engine faster than needed to effectively cut the vegetation.
19. Allow the engine to return to idle speed when not cutting.
20. Always turn off the engine and disconnect the spark plug, if accessible, before attempting to unclog or adjust the trimmer.
21. To avoid placing hands near the blade, use a stick to remove any vegetation clogging the unit.
22. Stop the engine before putting the cutter down.
23. Secure the cutter to prevent fuel spillage and damage during transport.
24. Ear plugs and/or ear muffs are required for brush cutter/trimmer operation and other high noise activities as deemed necessary by the SSHO.

3.4 MECHANIZED SHREDDER OPERATION

The mechanized shredder is a large excavator with a fuel powered vegetation and tree shredder attached to the boom. This attachment is very heavy and requires extreme care when being operated, especially in an area with munitions and explosives of concern (MEC). Excavator and shredder operations will be conducted in accordance with (IAW) the manufacturer's instructions and safety precautions. Additionally the excavator and shredder will be operated according to the following:

1. Shredder equipment operators are required to be trained in the operation, inspection and maintenance of shredder.
2. The shredder will be inspected prior to use each day.
3. Operator must stay in seat while machine is running.
4. Operator must know how to shut down in an emergency.
5. Operator must always have eye contact with the attachment.
6. Operator must be aware of personnel entering the work area.
7. An exclusion area shall be established to protect adjacent workers from the effects of flying debris inherent to such operations. When a person enters the work area, shut down the machine and inform them of the danger. Do not start the machine until non-protected personnel have cleared the exclusion area.
8. Operator and unexploded ordnance (UXO) sweep personnel must have radio communications when operating in a MEC contaminated area. Loss of communications will cause immediate work stoppage.

9. Operator will not enter any area until UXO personnel have swept the area and declared it safe for vegetation clearance.
10. Operator will not allow riders on or in machine.
11. Operator must keep the Shredder and boom a safe distance from obstructions, buildings, and power lines.
12. Never allow the Shredder to come within 6 inches of the ground at any time.
13. Only lift cutter drum as high as needed. Operation of cutter wheel more than 1 foot above ground is extremely dangerous.
14. Operator must use extreme care when on uneven or rough terrain. When on hillsides or steep inclines. Only track up and down slopes. On steep inclines do not operate over side of tracks.
15. Stay away from cliffs, overhangs, and uneven ground.
16. If machine starts to slide on sloped terrain, lower boom to ground to slow or stop slide.
17. DO NOT operate shredder more than 45 degrees from level. Engine damage **will** occur.
18. Keep machine under control and use common sense in operations.
19. Position throttle to idle and idle for 5 minutes prior to shut down.
20. Turn shredder ignition to OFF position, and lower carrier to ground and disengage excavator controls when shutting down operations.
21. Ear plugs or ear muffs required for Shedder operation and other high noise activities deemed necessary by the SSHO.

3.5 TREE FELLING PROCEDURES

3.5.1 General requirements

The general requirements listed below shall be followed during tree-felling operations.

1. Trees shall not be felled in a manner that may create a hazard for an employee, such as but not limited to, striking a rope, cable, power line, or machine.
2. The immediate supervisor shall be consulted when unfamiliar or unusually hazardous conditions necessitate the supervisor's approval before cutting is commenced.
3. No employee shall approach a feller closer than two tree lengths of trees being felled until the feller has acknowledged that it is safe to do so, unless the employer demonstrates that a team of employees is necessary to manually fell a particular tree.
4. No employee shall approach a mechanical felling operation closer than two tree lengths of the trees being felled until the machine operator has acknowledged that it is safe to do so.
5. Each danger tree shall be felled, removed or avoided. Each danger tree, including lodged trees and snags, shall be felled or removed using mechanical or other techniques that minimize employee exposure before work is commenced in the area of the danger tree. If the danger tree is not felled or

removed, it shall be marked and no work shall be conducted within two tree lengths of the danger tree unless the employer demonstrates that a shorter distance will not create a hazard for an employee.

6. Each danger tree shall be carefully checked for signs of loose bark, broken branches and limbs or other damage before they are felled or removed.
7. Accessible loose bark and other damage that may create a hazard for an employee shall be removed or held in-place before felling or removing the tree.
8. Felling on any slope where rolling or sliding of trees or logs is reasonably foreseeable shall be done uphill from, or on the same level as, previously felled trees.
9. Domino felling of trees is prohibited, unless this method is used to fell a single danger tree by felling another single tree into it.

3.5.2 Manual Felling

Before each tree is felled, conditions such as, but not limited to, snow and ice accumulation, the wind, the lean of tree, dead limbs, overall balance of the tree, and the location of other trees, shall be evaluated by the feller and precautions taken so to not create a hazard for the feller or other site personnel. During manual tree felling, the procedures listed below will be followed.

1. The chain-saw operator shall be certain of footing before starting to cut. The chain saw shall not be used in a position or at a distance that could cause the operator to become off-balance, to have insecure footing, or to relinquish a firm grip on the saw.
2. Prior to felling any tree, the chain-saw operator shall clear away brush or other potential obstacles that might interfere with cutting the tree or using the retreat path.
3. Before felling is started, the feller shall plan and clear a retreat path. The retreat path shall extend diagonally away from the expected felling line at an angle of approximately 45°. Once the backcut has been made the feller shall immediately shut down the saw, place the saw on the ground and move a safe distance away from the tree on the retreat path.
4. Start the facecut with a 45° notch on the side that the tree will fall towards. Cut the bottom of the notch first, about one third of the way through the diameter. The second cut is made at a 45° angle that will meet the depth of the first cut. The backcut (felling cut) should be made from the opposite side, about 2 inches higher than the floor of the notch. Do not cut all the way through but leave a hinge that will keep the tree from kicking back and upward as it falls. The hinge will be about 1/8 to 1/6 of the diameter where you are cutting but it may vary depending on when the tree starts to fall.
5. If a tree happens to be so well balanced that it does not fall after a felling cut has been made, two wedges can be used to start the fall and influence its

direction. Always use two wedges and a sledge that has a face 1/3 larger than the face of the wedge.

6. Always remove the chain saw when wedges are being driven into the cut. Strike the wedge carefully since a careless blow may cause the wedge to pop out of the cut and allow the tree to fall backward.
7. Never use an axe as the wedge or driver; the head of the axe may shatter and you could be injured by flying pieces of the axe. If cutting must be continued, insert the chain saw into the cut very carefully since the conditions are extremely dangerous.
8. When a spring pole or other tree under stress is cut, no employee other than the feller shall be closer than two trees lengths when the stress is released.

3.5.3 Limbing and Trunk Sizing

Limbing and trunk sizing (bucking) can create significant hazards for the chain saw operator and others in the area due to the movement of the tree that may result when the limbs are removed or the trunk is cut into manageable pieces. To minimize the hazards, the procedures outlined below will be followed during limbing and bucking operations.

1. Limbing and bucking on any slope where rolling or sliding of trees or logs is reasonably foreseeable shall be done on the uphill side of each tree or log.
2. Before bucking or limbing wind-thrown trees, precautions shall be taken to prevent the root wad, butt or logs from striking an employee. These precautions include, but are not limited to, chocking or moving the tree to a stable position.
3. An examination will be conducted to ensure the fallen tree is stable and will not move as the limbs are removed. The situation will be examined at every limb to be removed to ensure that the limb will not bind against the saw.
4. The chain saw operator will cut on the opposite side of the tree trunk whenever possible, thereby keeping the trunk between the operator and the saw.
5. The chain saw operator shall never stand on the downhill side when removing limbs, and personnel in the area will keep in mind that the tree trunk may roll as limbs are removed.
6. Personnel should always watch for limbs that may spring out when they are cut due to the released tension, as these limbs can cause injury.
7. Larger limbs may require more than one cut to be removed safely. The cuts should be planned so that the blade will not be bound. Stored energy in the limb or trunk can cause a cut to pinch the blade and immobilize the saw. Wedges can be used as previously mentioned, and the operator should plan an escape route when removing large limbs since they may roll when they become free of the tree trunk.
8. When cutting large limbs and the trunk of the tree into convenient lengths, ensure the trunk is supported along its entire length and will not roll.

9. To cut a large limb or trunk, cut downward from the top of the trunk (overbuck) about one-third of the diameter and then roll it over to make final cuts (underbuck).
10. Wedges can be used to keep the cut open if the log or limb cannot be rolled over. Again, wedges must be driven with care so as not to come in contact with the chain saw.

3.5.4 Kickback Hazards

Kickback of a chainsaw is when the teeth on the chain catch on something as they rotate around the tip of the blade. The teeth may have enough force to cause the blade to kick back violently toward the operator, hence the term "kickback." There are several situations that are prone to cause kickbacks:

1. When the nose of the blade strikes another object.
2. Starting a bore cut improperly.
3. When the blade nose or tip catches the bottom or side of a saw cut during reinsertion.

The best defense against kickback is to keep the tip guard on the chain saw. However this limits what can be done with the saw. Keeping a firm hold on the saw and using a saw that has a chain-brake or kickback guard can maintain some kickback control.

Chain saw operators should always be watchful for blade-pinching situations and plan accordingly. The base of the blade should be used to cut branches rather than the tip of the blade, and a high chain speed should be used when reinserting the blade in a cut or removing it from a cut. Since dull teeth are more likely to cause kickback, ensure that the saw teeth are sharp. Never cut above shoulder height, otherwise the saw will be difficult to control and there will be a high potential for kickback towards the head and face.

3.6 WOOD CHIPPING

During wood chipping operations, it is necessary to provide a safe work system and to comply with the appropriate safeguarding of machinery standards. Along with any manufacturer specific safety precautions or procedures, the procedures listed below will be followed:

1. Chipper access covers or doors shall not be opened until the drum or disc is at a complete stop.
2. Feed chute and discharge chute shall be guarded to prevent contact with the disc, knives, or blower blades.
3. The chipper shall be shut down and locked out in accordance with the requirements of Joint Venture (JV) SOP-521, Lockout/Tagout Safety, when an employee performs any servicing or maintenance.
4. Trailered chippers shall be chocked during usage on any slope where rolling or sliding of the chipper is reasonably foreseeable.

5. Operators shall be trained and supervised prior to and when using the machine.
6. Pruning material left on the ground in close proximity to the operator's position will be removed to prevent a trip hazard.
7. The operator shall not wear loose items of clothing that may get caught or snag on pruning material as it is fed into the chipper.
8. The operator shall feed the chipper from a side position away from the front of the in-feed chute and once the in-feed rollers catch the wood, the operator will then move away from the feed line of the chipper.
9. The butt end of branches shall be fed into the chipper in-feed rollers first.
10. At no time will personnel climb onto, or stand on the in-feed chute of the chipper, nor will anyone sit or ride on the in-feed chute of the chipper.
11. Adequate warning signs shall be posted as a constant reminder to operators of the potential hazards associated with the machine.
12. Ensure that the in-feed rollers are completely stopped prior to correcting an action or cleaning up small pieces of wood or leaves on the machine.
13. Guarding and emergency control mechanisms will be maintained in place and operational at all times when the machine is running.

3.7 OVERHEAD ELECTRIC LINES

Tree felling operations near overhead electric lines shall be done in accordance with the requirements of 29 CFR 1910.333(c)(3). The SS shall notify the power company immediately if a felled tree makes contact with any power line. Each employee shall remain clear of the area until the power company advises that there are no electrical hazards.

3.8 FLAMMABLE AND COMBUSTIBLE LIQUIDS

Flammable and combustible liquids shall be stored, handled, transported, and used in accordance with the requirements of SOP-511, Fire Protection.

3.9 VEGETATION REMOVAL EQUIPMENT INSPECTION AND MAINTENANCE

3.9.1 General Requirements

All equipment used in vegetation and tree removal will be inspected prior to use each day. Equipment inspections will also be conducted periodically throughout the day during refueling. Any equipment found to be defective and in need of repair by an authorized service center will be reported to the SS and SSHO, tagged as out of service, properly repaired and re-inspected prior use. If any equipment is found to be in need of routine maintenance or other approved adjustment that can be made by the operator, the service shall be conducted prior to resuming operations.

3.9.2 Chain Saw Inspection and Maintenance

As a minimum, chain saw inspection will include the following:

1. Controls, to assure proper function;

2. Chain saw chains, to assure proper adjustment;
3. Chain saw mufflers, to assure that they are operational and in place;
4. Chain brakes and nose shielding devices, to assure that they are in place and function properly;
5. Cutting edges, to assure that they are sharp and properly shaped; and
6. All other safety devices, to assure that they are in place and function properly.
7. If chainsaw is in need of repair the chainsaw will be tagged as out of service, properly repaired and re-inspected prior use.

3.9.3 Chipper Inspection and Maintenance

The wood chipper shall be inspected and maintained in accordance with the manufacturer's instructions, but not less than one inspection prior to use each day. At no time will the chipper be operated if the required controls and guards are not in place. If chipper is in need of repair the chipper will be tagged as out of service, properly repaired and re-inspected prior use.

3.9.4 Gas Powered Brush Cutter/Trimmer Inspection and Maintenance

Inspect the brush cutter periodically for potential hazards such as loose belts, and missing or damaged guards. Examine for accumulations of grass, leaves or excessive grease to reduce fire hazard. Conduct routine maintenance and inspections in accordance with the manufacturer's operation manual. If brush cutter/trimmer is in need of repair the cutter/trimmer will be tagged as out of service, properly repaired and re-inspected prior to placing back in service.

3.9.5 Shredder Inspection and Maintenance

To conduct inspection and maintenance on the shredder, the general steps outlined below shall be conducted. However, manufacturer requirements will be used if different then the procedures listed below.

1. Follow normal shutdown procedures.
2. Check machine systems (fuel, air, water, oil hydraulic)
3. Make sure machine is free of debris and flammable fluids.
4. Make sure bolts, covers, and safety equipment is secure.
5. Check cutter drum for damaged teeth, blocks, or holders.
6. Grease machine every two hours (see operators manual.)
7. The shredder air filter box has an air filter restriction indicator. It is located inside the engine compartment on the side of the filter housing. When the filter indicator is red, the filter should be changed.
8. If the shredder is in need of repair the shredder will be tagged as out of service, properly repaired and re-inspected prior to placing back in service.

3.9.6 Training

Chain saw, brush cutter and Shredder operations training shall be provided to each employee, including supervisors. This training shall be provided according to the following:

1. Prior to initial assignment for each new employee;
2. Whenever the employee is assigned new work tasks, tools, equipment, machines or vehicles; and
3. Whenever an employee demonstrates unsafe job performance.
4. The training shall be designed and presented to address the following elements:
    a. Safe performance of assigned work tasks;
    b. Safe use, operation and maintenance of tools, machines and vehicles the employee uses or operates, including emphasis on understanding and following the manufacturer's operating and maintenance instructions, warnings and precautions;
    c. Recognition of safety and health hazards associated with the employee's specific work tasks, including the use of measures and work practices to prevent or control those hazards;
    d. Recognition, prevention and control of other safety and health hazards in the vegetation removal and logging industry;
    e. Procedures, practices and requirements of the employer's work site; and
    f. The requirements of the Occupational Safety and Health Administration (OSHA) logging standard.

Each new employee and each employee who is required to be trained shall work under the close supervision of a designated person until the employee demonstrates to the employer the ability to safely perform their new duties independently.

3.9.7 First-aid Training Requirements

At least two full-time site employees shall be trained and certified in first aid and cardiopulmonary resuscitation (CPR). Whenever possible, the SSHO will be one of the two site personnel. The training shall be equivalent to that provided by the American Red Cross.

3.9.8 First-aid Supplies and Kits

In accordance with Appendix B of 29 CFR 1910.266, the list outlined below sets forth the minimally acceptable number and type of first-aid supplies for first-aid kits required for logging operations. The size and number of first aid kits shall be sufficient to accommodate the maximum number of people (including any visitors) on-site at any given time. Standard 16-unit first aid kits will be located with each team and two trauma kits will be maintained on-site. Additionally, first aid kits will be provided with adequate water, gel burn bandages, and other supplies necessary to cleanse burns,

wounds, or lesions. The first aid supplies listed below have been assessed and approved by the JV's consulting licensed physician. First aid kits will be inspected at least weekly and maintained in operational order.

- A minimum of a 16-Unit first aid kit with each team (i.e., each team performing distinct tasks).
- Bloodborne pathogen protection kit.
- Portable eye wash bottles for use during transportation to the 15-minute eye wash station.
- Burn kit with bandages.
- Trauma bandages.
- A fire blanket.
- Fire extinguisher.

3.10 PERSONAL PROTECTIVE EQUIPMENT

The JV shall assure that PPE used on-site, including any PPE provided by an employee, is maintained in a serviceable condition. The employer shall assure that PPE, including any PPE provided by an employee, is inspected before initial use during each work shift. Defects or damage shall be repaired or the unserviceable PPE shall be replaced before work is commenced.

The JV shall provide, at no cost to the employee, and assure that each employee who operates a chain saw or gas powered brush cutter wears the following PPE:

1. Leg protection constructed with cut-resistant material, such as ballistic nylon, that covers the full length of the thigh to the top of the boot on each leg.
2. Foot protection, such as heavy-duty logging boots that are waterproof or water repellent, and that cover and provide support to the ankle.
3. Head protection, such as a hardhat that shall be worn in areas where there is a potential for head injury from falling or flying objects.
4. Eye protection where there is a potential for eye injury due to falling or flying objects; and
5. Face protection where there is potential for facial injury such as, but not limited to, operating a chipper. Employees performing chain-saw operations may wear logger-type mesh screens.
6. Plastic shin guards may be worn when using a brush cutting blade on the gas powered brush cutter.

4.0 REFERENCES

The following OSHA standards directly apply to the conduct of operations associated with the SOP. In the event other hazards are associated with the conduct of this SOP, consultation of other SOPs and regulatory references may be needed. Additionally, this SOP has been designed to meet the U.S. Army Corps of Engineers (USACE) requirements outlined below.

- OSHA General Industry Standard 29 CFR 1910.266, Logging.
- USACE EM 385-1-1, Section 13, Hand and Power Tools.
- USACE EM 385-1-1, Section 18.0, Machinery and Mechanized Equipment.
- USACE EM 385-1-1, Section 31, Tree Maintenance and Removal
- The owner's manual for equipment and machinery used.

5.0 ATTACHMENTS

No attachments associated with this SOP.

SOP-601: STANDARD OPERATING PROCEDURES FOR MEC SURFACE SWEEPS

Contents

ACRONYMS

EOD .....Explosives Ordnance Disposal
EZ.....Exclusion Zone
JV ..... Joint Venture
MDAS .....Material Documented As Safe
MEC.....Munitions and Explosives of Concern
MSD.....Minimum Separation Distance
MGFD .....Munitions with the Greatest Fragmentation Distance
MPPEH .....Material Potentially Presenting an Explosive Hazard
PLS.....Professionally Licensed Surveyor
SAP .....Sampling and Analysis Plan
SOP .....Standard Operating Procedure
SSHP.....Site Safety and Health Plan
SUXOS .....Senior UXO Supervisor
UXO.....Unexploded Ordnance
UXOQC .....UXO Quality Control
UXOSO.....UXO Safety Officer

STANDARD OPERATING PROCEDURE – 1
MEC SURFACE SWEEPS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide all PIKA International, Inc. (PIKA)/Malcolm Pirnie, Inc. (PIRNIE) Joint Venture (JV), LLC ("the JV") employees and subcontractors with the minimum procedures and safety and health requirements applicable to perform surface sweep operations at sites potentially containing unexploded ordnance (UXO) and/or munitions and explosives of concern (MEC).

2.0 SCOPE

This SOP applies to all PIKA/MALCOLM PIRNIE JV site personnel, including contractor and subcontractor personnel, involved in the conduct of surface sweep operations on a UXO/MEC site. The following JV policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with the project Work Plan and MEC Sampling and Analysis Plan (SAP), other project-specific SOPs, the Site Safety and Health Plan (SSHP), applicable Federal, State, and local regulations, and contract restrictions and guidance. Consult the documents listed in Section 5.0 of this SOP for additional compliance issues.

3.0 SURFACE SWEEP OPERATIONS

All surface sweep operations at MEC sites will be performed under the direct supervision of UXO qualified personnel. Non-UXO qualified personnel will not be allowed in the exclusion zone (EZ) during intrusive operations. If access is required by non-UXO qualified personnel, all work will stop while they are in the EZ. During surface sweep operations, PIKA/PIRNIE JV personnel will strictly adhere to the SSHP and the following general safety practices:

- Operations will be conducted during daylight hours only.
- Access to operating areas will be limited to only those personnel necessary to accomplish the specific operation.
- UXO will only be handled by qualified UXO Technicians.
- During UXO operations the minimum separation distance (MSD) between UXO and non-UXO operations is fragmentation distance of the munition with the greatest fragmentation distance (MGFD), as stated in the Explosive Site Plan.
- During demolition operations personnel remaining on site will be limited to those personnel needed to safely and efficiently prepare the item/s for destruction.
- All personnel will attend the daily safety briefing (tailgate safety briefing) prior to entering the operating area.

- Anyone can stop operations for an unsafe act or situation.
- Safety violations and/or unsafe acts will be immediately reported to the UXO Safety Officer (UXOSO).
- Failure to comply with safety rules/procedures may result in termination of employment.

3.1 SITE LAYOUT PROCEDURES

The surface sweep grids will be established by a Professionally Licensed Surveyor (PLS), licensed in the state of New Mexico. Survey crews will be escorted in the field by a UXO Technician II who will provide UXO avoidance in accordance with SOP-352 including checking the intended survey stake locations with a magnetometer prior to driving stakes into the ground, which will prevent driving stakes into buried MEC. The site layout procedures are as follows:

- Identify and mark the operating area boundaries:
  - The PLS will mark the site boundary with wooden survey stakes, with black and/or yellow survey tape, approximately every 200 meters. The stakes should be visible from one to the next. Therefore depending on the terrain, it may be necessary to place them closer together.
- Identify and mark search grids:
  - The PLS will establish the corners of the 100-feet (ft) x100-ft surface sweep grids.
  - The PLS will establish grid corners with survey wooden stakes with orange survey tape.
  - The UXO team will establish temporary survey lanes with white pin flags or twine/string.
- Establish and, mark if required, search lanes:
  - A typical search lane will be a width of approximately 5 feet. The lanes may or may not be established prior to sweeping. If temporary lanes are marked prior to sweeping it will be done by a UXO technician to ensure safety.

3.2 SWEEP PROCEDURES

Sweep teams will be assigned as appropriate to the individual operation and in accordance with DDESB TP-18. The sweeps will be performed to identify MEC, material potentially presenting an explosive hazard (MPPEH), and material documented as safe MDAS) may be for surface (visible). Regardless of the type of clearance, MEC operations will only be performed by qualified UXO Technicians.

- MEC operations are defined as:
  - MEC identification

- Access procedures such as excavation, either by hand or using heavy equipment
- Handling of UXOs, explosives, or explosive items

3.2.1 FLAGS AND MARKERS

The JV will use a system of colored flags/flagging and markers to identify MEC, scrap metal, sweep lanes, and site, zone, and grid boundaries. Table 1 lists the types of markers used.

Table 1: Marking Material

Type Marker	Flag/Flagging Color	Item/Area Marked
Wooden Stake	Black and Yellow	Site boundary
Wooden Stake	Red and Orange	Zone boundary
Wooden Stake	Orange	Grid boundary
Pin Flag	White	Temporary Boundary
Pin Flag	Red	MEC
Pin Flag	Yellow	Subsurface Anomaly
Pin Flag	Blue	MEC Scrap
Pin Flag	Green	Non-MEC Scrap

3.2.2 SURFACE SWEEP

The purpose of a surface sweep of a grid is two-fold: first to locate, mark, and record the location of the surface MEC/MPPEH, MDAS contained in each grid; and second to consolidate the surface scrap metal within each grid. The typical span of control for a UXO Technician is three to five sweepers. This ensures positive control and safety.

3.2.2.1 Sweep Team Structure

The sweep team will consist of either all UXO Technicians or a mix of UXO and Non-UXO personnel. The following is an example and composition of a typical Sweep Team:

- One UXO Technician III, who directs and supervises all team activities, confirms the identification of all MEC encountered, and maintains the sweep team journal.
- One UXO Technician II who assists the UXO Technician III, identifies all MEC encountered, and records the location of the items located.
- Five sweepers (either UXO Technicians or General Laborers) who visually search the area for MEC. These personnel perform their duties under the direction and supervision of the UXO Technician III.

3.2.2.2 Surface Sweep Team Procedures

All sweep operations will be performed under the direct supervision of a qualified UXO Technician III. The UXO Technician III will assemble the sweepers into a sweep line and direct their movement across the survey grid.

- Sweepers will be spaced approximately 5 feet apart and, at the direction of the UXO Technician III, move through the grid on line abreast.
  - When an item is encountered, the individual will call out "hold the line", and hold up his/her hand. The line will stop and the UXO Technician II will inspect the object to determine if it is MEC or scrap and mark the item with the appropriate colored Pin Flag. The line will not move again until directed by the UXO Technician III.
  - As the team moves forward the sweeper at the edge of the grid will use the grid stakes as one sweep lane boundary, the sweeper on the opposite end of the line will mark the limit of the sweep lane with White Pin Flags. These flags become the guide for the return sweep and define the limits of the previously cleared lane.
  - This procedure is continued until the grid is completely swept.
- The UXO Technician III will follow behind the sweep line insuring that proper spacing is maintained, inspect and verify the identification of the flagged items, and record data on the type, nomenclature, and location of identified MEC, MPPEH, and MDAS.
- Upon completion of the grid sweep the sweep team will recover and stockpile metal scrap at a central location. Under the direct supervision of the UXO Technician III, the scrap will be stockpiled in a central location in the grid. Items marked with Red Pin Flags will be left in place for the Disposal Team.

UNDER NO CIRCUMSTANCES WILL GENERAL LABORERS HANDLE OR MOVE MEC/UXO.

3.2.3 MAGNETOMETER ASSISTED SURFACE SWEEP

Magnetometer assisted surface sweep procedures are basically the same as surface sweeps. In addition to identifying surface MEC/MPPEH/MDAS, magnetometers are used to locate MEC that may be concealed by brush or heavy grasses. Instructions on the use and calibration of magnetometers are in the JV magnetometer SOP. The purpose of a magnetometer assisted-surface sweep of a grid is to first locate, mark, and record the location of the surface MEC contained in each grid; and second to consolidate the scrap metal within each grid. The typical span of control for a UXO Technician is three to five magnetometer operators. This ensures positive control and safety.

3.2.3.1 Magnetometer Assisted Surface Sweep Team Structure

The sweep team will consist of either all UXO Technicians or a mix of UXO and Non-UXO personnel. The following is the structure and composition of a typical Sweep Team:

- One UXO Technician III, who directs and supervises all team activities, confirms the identification of all MEC encountered, and maintains the sweep team journal.
- Two UXO Technicians II who assist the UXO Technician III, identify all MEC encountered, excavate and identify buried contacts, and record the location of the items located/detected.
- Five Magnetometer Operators (either UXO Technicians or trained General Laborers) who visually and electronically search the area for MEC. These personnel perform their duties under the direction and supervision of the UXO Technician III.

3.2.3.2 Magnetometer Assisted Surface Sweep Team Procedures

All sweep operations will be performed under the direct supervision of a qualified UXO Technician III. The UXO Technician III will assemble the Magnetometer Operators into a sweep line and direct their movement across the survey grid. Procedures will be the same as detailed in Section 3.2.2.2 with the exception that the Magnetometer Operators will utilize the magnetometer to assist in searching in heavy brush and grass.

4.0 DISPOSAL OPERATIONS

Disposal of any MEC or MPPEH items located during field activities will be conducted in accordance with SOP-207.

5.0 REFERENCES

- USACE Safety Considerations for UXO
- PIKA-MALCOLM PIRNIE/JV Corporate Safety and Health Program (CSHP)
- OSHA, 29 CFR 1910, Occupational Safety and Health Standards
- OSHA, 29 CFR 1926, Construction Standards
- Applicable sections of EPA, 40 CFR Parts 260 to 299, Protection of Environment
- Applicable sections of DOT, 49 CFR Parts 100 to 199, Transportation
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous Waste Remedial Actions
- DOD 4145.26-M, Contractors' Safety Manual for Ammunition and Explosives
- DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards DOD 6055.9 STD
- DOD 4160.21-M, Defense Reutilization and Marketing Manual
- DA PAM 385-64, Ammunition and Explosives Safety Standards
- AR 385-64, Ammunition and Explosives Safety Standards
- AR 200-1, Environmental Protection and Enhancement
- AR 385-10, The Army Safety Program
- AR 385-16, System Safety Engineering and Management
- AR 385-40 w/USACE supplement, Accident Reporting and Records
- TM 9-1300-200, Ammunition General
- TM 9-1300-214, Military Explosives
- TM 60 Series Publications

SOP-602: STANDARD OPERATING

PROCEDURES FOR

MEC ANOMALY AVOIDANCE

Contents

ACRONYMS

DPT .....Direct Push Technology
EOD .....Explosives Ordnance Disposal
EMM .....Earth Moving Machinery
EMR .....Electromagnetic Radiation
JV ..... Joint Venture
MEC .....Munitions and Explosives of Concern
MPPEH .....Material Potentially Presenting an Explosive Hazard
PPE.....Personal Protective Equipment
SAP .....Sampling and Analysis Plan
SOP .....Standard Operating Procedure
SSHP .....Site Safety and Health Plan
UXO .....Unexploded Ordnance

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide all PIKA International, Inc. (PIKA)/Malcolm Pirnie, Inc. (PIRNIE) Joint Venture (JV), LLC, ("the JV") employees and subcontractors with the minimum procedures and safety and health requirements applicable to perform anomaly avoidance operations at sites potentially containing unexploded ordnance (UXO) and/or munitions and explosives of concern (MEC).

2.0 SCOPE

This SOP applies to all JV site personnel, including contractor and subcontractor personnel, involved in the conduct of avoidance operations on a UXO/MEC site. The following JV policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with the project Work Plan, the MEC sampling and analysis plan (SAP), other JV SOPs, the JV Site Safety and Health Plan (SSHP), applicable Federal, State, and local regulations, and contract restrictions and guidance. Consult the documents listed in Section 8.0 of this SOP for additional compliance issues.

3.0 MEC/UXO BASIC AND GENERAL SAFETY PRECAUTIONS

These basic safety precautions are the minimum MEC safety requirements required of all JV personnel, including sub-contractors on site. Other precautions and requirements are in other applicable MEC manuals.

3.1 BASIC CONSIDERATIONS

The following should be taken into consideration when planning or conducting MEC avoidance support operations:

- SAFETY IS PARAMOUNT
- Do not move or disturb unidentified items
- Do not collect souvenirs
- Do not smoke except in designated areas
- Do not carry fire or spark producing devices into the site
- All MEC operations will use the "Buddy" system
- Prohibit non-essential personnel from visiting the site

3.2 BASIC SAFETY PRECAUTIONS

The following safety precautions are applicable to all MEC and material potentially presenting an explosive hazard (MPPEH):

- Suspend all operations immediately upon approach of an electrical storm.
- Observe the hazards of electromagnetic radiation (EMR) precautions and grounding procedures when working with, or on, electrically initiated or susceptible MEC.
- Do not unnecessarily dismantle, strip, or handle any MEC.
- Avoid inhalation and skin contact with smoke, fumes, dust, and vapors of detonations and MEC residue.
- Do not attempt to extinguish burning explosives or any fire that might involve explosive materials.
- Do not manipulate external features of ordnance items.
- Incorporate appropriate property and personnel protective measures for shock and fragmentation when conducting MEC operations.
- Do not subject MEC to rough handling or transportation. Sand bag, chock, and block appropriately.
- Hand carry no more than two items (one in each hand) at a time and then only as required by the operation being performed.
- Do not transport damaged white phosphorous munitions unless fully submerged in water.
- Avoid unnecessary movement of armed or damaged UXO.
- Avoid the forward portions of munitions employing proximity fuzing.
- Assume unknown fuzes contain cocked strikers or anti-disturbance features.

3.3 GENERAL SAFETY PRECAUTIONS

The following sub-paragraphs describe safety precautions for various types of munitions/disposal operations:

3.3.1 BOMBS

- Ensure fuze wells do not contain fuze components.

3.3.2 CLUSTERS, DISPENSERS, LAUNCHERS

- Approach and work from the sides of a dispenser.

- Consider an intact dispenser as fully or partially loaded.
- Consider any payloads outside the container or dislodged inside as armed.
- Take precautions for the most hazardous payloads until positively identified.

3.3.3 PROJECTILES

- Determine if the projectile has been fired and if so consider it armed.
- Check for the presence of unburned tracers.
- Avoid the rear and front of rocket assisted projectiles,
- Handle projectile components such as powder increments, cartridges, and primers with caution.
- Seal the open ends of projectiles or sheared projectile components with tape or other suitable material before transporting.

3.3.4 GRENADES

- Do not attempt to re-install safety pins on a dud-fired grenade.
- Do not attempt to withdraw impinged firing pins from the fuze of a dud-fired grenade.
- Do not dispose of grenades by functioning them as designed.

3.3.5 ROCKETS

- Approach and work on rockets from the side.
- Do not dismantle or strip dud fired rockets or rocket motors.
- Do not expose electrically fired munitions to radio transmissions within 25 feet.
- Do not transport an unfired rocket motor until having shielded the motor igniter from EMR.

3.3.6 GUIDED MISSILES

- When found, restrict vehicular movement in the area of a guided missile.
- Avoid entanglement with guidance wires of wire guided missiles.
- Restrict radio communications in the vicinity of a dud-fired missile.
- Approach and work on missiles from the side and rear quarter.
- Do not dismantle or strip dud-fired missiles or missile motors.

- Do not transport an unfired missile motor until having shielded the motor igniter from EMR.

4.0 MEC AVOIDANCE FOR SAMPLING AND DRILLING OPERATIONS

MEC avoidance operations may be required in support of soil sampling operations and the drilling of monitoring wells on some contracts. Avoidance operations will consist of a team composed of two UXO qualified personnel. The team will consist of a UXO Technician III and a UXO Technician II or UXO Technician I.

4.1 ACCESS ROUTES TO SAMPLING LOCATIONS

Prior to sampling or well drilling crews going on site, the MEC team will conduct a reconnaissance of the sampling area. The reconnaissance will include locating the designated sampling or drilling location and insuring that it is free of anomalies. If anomalies are detected the point will be relocated as directed in the Work Plan. Once the designated point has been cleared, an access route for the sampling crews, vehicles and equipment will be cleared. The access route, at a minimum, will be twice the width of the widest vehicle and the boundaries will be clearly marked to prevent personnel from straying into un-cleared areas. If surface MEC is encountered, the MEC team will mark and report the item, and divert the approach path around the MEC. A magnetometer will be used to ensure there are no subsurface MEC within the approach path. If a subsurface magnetic anomaly is encountered, it will be assumed to be a possible MEC and the path diverted to avoid it.

4.2 SOIL SAMPLING AND WELL DRILLING SITES

The MEC team will clear a work site for soil samples and well drilling and clearly mark the boundaries. The area will be large enough to accommodate the drilling equipment and provide a work area for the crews. As a minimum, the cleared area will be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment for use on site. If a pre-selected area indicates magnetic anomalies, a new sampling/drilling site will be chosen.

4.3 AVOIDANCE PROCEDURES FOR BOREHOLE SAMPLING

If surface samples are required they will be obtained prior to the start of boring. The borehole procedures will be completed using a hand auger, powered auger, or Direct Push Technology (DPT) equipment. The MEC Team will check the borehole with a down-hole magnetometer, a minimum of every 2 feet, to the deepest sampling depth, or a minimum of 10 feet, to ensure that smaller items of MEC, undetectable from the surface, will be detected.

- **Hand Auger Procedures:** The hand auger will be advanced to the first sampling depth and the auger will be withdrawn. A clean auger bucket will be attached to the handle, returned to the borehole and a sample will be collected. At this point the MEC Team will check the borehole with a magnetometer and if no magnetic anomalies are found, the procedure repeated to obtain the required samples.
- **Power Auger Procedures:** The power auger will be advanced to the first sampling depth and the auger will be withdrawn. A clean hand auger will then be used to collect the sample. The MEC Team will check the borehole with a magnetometer and if no magnetic anomalies are found, the procedure will be repeated to collect the required samples.
- **DPT Procedures:** The DPT rig will be positioned over the sampling point and the rod will be advanced to a maximum depth of 2 feet. The DPT rig will then move a minimum of 20 feet away from the sampling point to prevent the rig from influencing the magnetometer. The MEC Team will then check the borehole with a magnetometer and if no magnetic anomalies are found, the procedure will be repeated to collect the required samples.

4.4 AVOIDANCE PROCEDURES FOR MONITORING WELL INSTALLATION

Prior to drilling equipment being moved to the proposed site, the MEC Team will have checked the designated site, using a magnetometer; to assure that the well location is anomaly free to a depth of 2 feet. If surface samples are required they will be collected prior to the start of drilling. To complete the subsurface magnetometer checks, one of two methods may be used:

- Monitoring, at 2-foot increments, during the actual well drilling operation. This will require the withdrawal of the drill rod or augers from the well and moving the drill rig a minimum of 20 feet away from the well location to prevent the rig from influencing the magnetometer, or
- Installing an offset monitoring hole within 2 feet of the well location. This monitoring hole can be installed by the MEC Team, with a hand or power auger, and monitored at 2-foot increments to the desired well depth or a minimum of 10 feet. This will then allow uninterrupted well installation and/or sampling to continue.

5.0 MEC AVOIDANCE AND CONSTRUCTION SUPPORT

MEC avoidance support is normally comprised of a two-man team consisting of a UXO Technician III (Team Leader) and a UXO Technician II. At sites where the expectation of encountering MEC is low, the MEC support may only consist of the UXO Technician III as MEC safety escort. The intent of MEC avoidance is to detect and avoid MEC and UXO. The following paragraphs outline minimum procedures for the designated operations.

5.1 LOCATION SURVEYS AND GEOPHYSICAL ESCORT

MEC escort for survey and geophysical operations consists of a visual surface search for MEC. Any UXO or MEC encountered will be marked, avoided, and reported to the appropriate authorities. Prior to driving stakes for grid corners or installing monuments, the UXO Technician will search the location with a magnetometer. Any subsurface anomaly will be assumed to be MEC and an alternate anomaly-free location will be chosen.

5.2 TRENCHING AND PIT EXCAVATION

Prior to trenching or excavation crews going on site, the MEC Team will conduct a reconnaissance of the approach route to the site. The reconnaissance will include locating a clear path for the crews, vehicles, and equipment. The approach path, at a minimum, will be twice the width of the widest vehicle. The boundaries of the approach path will be clearly marked to prevent personnel from straying into un-cleared areas. If MEC is encountered, the MEC team will mark and report the item, and divert the approach path around the MEC. Personnel will be instructed to remain within the marked boundary limits. A magnetometer will be used to search for near surface anomalies within the approach path. If a magnetic anomaly is encountered, it will be assumed to be a possible MEC, it will be marked, the approach path diverted, and reported.

5.2.1 EXCAVATION

During excavation operations, the UXO Technician(s) will position themselves near (outside the reach of the swing) the earth moving machinery (EMM) (backhoe) where they can observe the excavation. If UXO or MEC is spotted the UXO Technician will signal the EMM operator to stop digging, move the bucket and place it on the ground outside the trench, and remove his hands from the controls. The UXO Technician will then investigate the MEC, which will be handled in accordance with Section 6.0. If MEC that cannot be moved is encountered the excavation operations will be either relocated to another area of operations or suspended until the item is disposed of or rendered safe to move.

5.2.2 HEAVY EQUIPMENT OPERATION

Heavy equipment safety will be in accordance with the SSHP.

5.2.3 EXCAVATION SAFETY

Excavation safety will be in accordance with the SSHP.

5.2.4 EQUIPMENT

The minimum equipment requirements for this activity include:

- Level D Personal Protective Equipment (PPE)
- EMM, (trenching & excavation)
- Schonstedt GA-52CX Magnetometer
- Marking material listed in Table 1
- Miscellaneous common hand tools (e.g. hammer, shovel, etc.)

Table 1: Color Codes – MEC Avoidance

Color	Description
Red Pin Flag/Caution Tape	Danger, identified suspect MEC/UXO, special precaution required
White Pin Flag	Boundary or temporary marker
Green Paint	Marking MEC-related scrap

6.0 LIVE AND SUSPECT MEC

UXO or MEC encountered will be inspected by the UXO Technician(s). Items that are safe to move may be relocated to a bermed or sandbagged area a safe distance from ongoing operations. No items will be moved unless positively identified and determined safe to move. The item(s) will be marked and reported to the Project Manager. MEC encountered that is ***NOT*** safe to move will be marked in place and operations will be moved to another location. MEC will be marked by installing four wooden stakes and encircling the stakes with flagging tape (see Table 1). Prior to installing stakes the location will be checked with a magnetometer to avoid driving the stake into a subsurface anomaly. All live and suspect live items will be inspected and identified by UXO Technicians. If the item cannot be positively identified and determined to be inert and safe to move, it will be marked and reported.

Note: If during identification of UXO or MEC it becomes necessary to move or handle the item, non-UXO qualified personnel will withdraw to a safe distance.

6.1 MEC-RELATED MATERIAL

Adjacent to each operating area, the UXO Technicians will establish a MEC-related scrap (munitions debris) collection point. During operations items that are free of explosive contamination (i.e., fragments, parachutes, etc.) will be placed into these collection points and marked (see Table 1). Upon completion of operations, the materials in these temporary collection points will be transferred to a central collection point for disposal. As the material is being loaded, the UXO Technician(s) will perform a second inspection of the material to ensure it is free of explosives and other hazardous materials.

7.0 DISPOSAL OPERATIONS

All MEC and MPPEH will be disposed of in accordance with procedures outlined in SOP-207. All hazardous material encountered will be reported to the Site Manager for disposition.

8.0 SUMMARY

The JV uses proven procedures and methods to provide MEC Support Services. Only qualified UXO personnel will perform tasks associated with MEC location, identification, and item condition determination. The procedures outlined in this SOP are based on industry standards and ensure that operations are safely and efficiently performed.

9.0 REFERENCES

- EP 385-1-95a, Basic Safety Concepts and Considerations for Ordnance and Explosives Operations
- EP 75-1-2, UXO Support during HTRW and Construction Activities
- USAE Corporate Safety and Health Program (CSHP)
- OSHA, 29 CFR 1910, Occupational Safety and Health Standards
- OSHA, 29 CFR 1926, Construction Standards
- Applicable sections of EPA, 40 CFR Parts 260 to 299, Protection of Environment
- Applicable sections of DOT, 49 CFR Parts 100 to 199, Transportation
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous Waste Remedial Actions
- DOD 4145.26-M, Contractors' Safety Manual for Ammunition and Explosives
- DOD 6055.9-STD, DoD Ammunition and Explosives Safety Standards
- DOD 4160.21-M, Defense Reutilization and Marketing Manual
- DA PAM 385-64, Ammunition and Explosives Safety Standards
- AR 385-64, Ammunition and Explosives Safety Standards
- AR 200-1, Environmental Protection and Enhancement
- AR 385-10, The Army Safety Program
- AR 385-16, System Safety Engineering and Management
- AR 385-40 w/USACE supplement, Accident Reporting and Records
- TM 9-1300-200, Ammunition General

- TM 9-1300-214, Military Explosives
- TM 60 Series Publications

SOP-603: STANDARD OPERATING

PROCEDURES FOR

EM61-MK2 DGM DATA COLLECTION

CONTENTS

ACRONYMS

DGM .....Digital Geophysical Mapping
DGPS .....Differential Global Positioning System
ESTCP.....Environmental Security Technology Certification Program
ft .....feet
FTL .....Field Team Leader
ftp .....file transfer protocol
GIS .....Geographic Information System
ISO .....Industry Standard Object
IVS .....Instrument Verification Strip
JV .....PIKA/Pirnie Joint Venture
LFO .....Least Favorable Orientation
MCAGCC .....Marine Corps Air Ground Combat Center
MEC.....Munitions and Explosives of Concern
MFO.....Most Favorable Orientation
MRS .....Munitions Response Site
NMEA.....National Marine Electronics Association
NRL.....Naval Research Laboratory
PLS.....Professionally Licensed Surveyor
QA.....Quality Assurance
QC .....Quality Control
RI.....Remedial Investigation
RTK.....Real Time Kinematic
SOP .....Standard Operating Procedure
SSHP .....Site Safety and Health Plan
UXO.....Unexploded Ordnance
UXOQC .....UXO Quality Control Specialist

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide PIKA International, Inc. (PIKA)/Malcolm Pirnie, Inc. (PIRNIE) Joint Venture (JV), LLC ("the JV") employees and subcontractors with the minimum procedures and safety and health requirements applicable to the conduct of digital geophysical mapping (DGM) using the Geonics EM61-MK2 with a real-time-kinematic (RTK) differential global positioning system (DGPS) on sites impacted by munitions and explosives of concern (MEC). This SOP ensures that data will be acquired in a consistent manner during the Remedial Investigation at Munitions Response Program Site (MRS) Unexploded Ordnance (UXO) 01 at Marine Corps Air Ground Combat Center (MCAGCC).

2.0 SCOPE

This SOP applies to the collection of geophysical and associated coordinate data. This SOP is not a stand-alone document and is to be used together with the project Work Plan, the MEC Sampling and Analysis Plan (SAP), other JV SOPs, the JV Site Safety and Health Plan (SSHP), applicable Federal, State, and local regulations, and contract restrictions and guidance. Consult the documents listed in Section 5.0 of this SOP for additional compliance issues.

A DGPS will be coupled with the geophysical instrument to record the positional x and y coordinates for the DGM data. The JV will use the Geonics EM61-MK2, in a man-portable platform, to collect DGM data. The objective of the DGM survey is to detect subsurface metallic objects that may be related to MEC. These objects may represent a hazard for future activities planned for the site.

The DGM sensor will be tested at an Instrument Verification Strip (IVS) prior to collecting DGM data and at the beginning and end of each day to ensure the instrumentation is functioning properly.

3.0 TRAINING REQUIREMENTS

All personnel assigned to the geophysical investigation teams require an initial certification in the IVS. Each team member must demonstrate the ability to perform assigned task associated with the geophysical investigation with the equipment at the approved IVS. This equipment includes the Trimble DGPS system coupled with the EM61-MK2 in cart mode.

If the equipment requires repair, it must be recertified prior to field use, and all new or spare equipment must be certified prior to field use. Newly assigned personnel must complete an initial certification of the IVS.

Prior to initiation of DGM data collection, training sessions will be held for all personnel responsible for DGM and the downloading and QC of data. Survey methodology, data requirements, field note protocol, and transect deviation documentation will be explained in detail. The presentations will include an overall discussion of the survey approach and

how the data collection and field documentation tasks integrate into the overall program. Training will also include review of the internal QC procedures listed in this SOP.

The Senior Geophysicist will be responsible for this training and any follow-up training deemed necessary.

4.0 PREPARATORY ACTIVITIES

4.1 GRID LAYOUT AND METHODS

Geophysical surveys may be conducted in gridded or non-gridded format. For either format a Professionally Licensed Surveyor (PLS), licensed in the state of the survey, will establish the boundary of the survey area. If a gridded format is required, the PLS will establish each grid corner within the survey area. Corners will be staked and marked.

The Geographic Information Systems (GIS) Manager will provide a map showing the locations of each grid and a list of DGPS coordinates for each grid corner.

4.2 BLIND SEEDING PROGRAM

The Army will conduct blind seeding within the production DGM grids to confirm that the DGM sensor operability is within the project's performance criteria. Blind seeding will involve the discrete placement of small industry standard objects (ISOs), representative of munitions located in the project areas, ahead of geophysical/removal teams. The Naval Research Laboratory (NRL) has shown that the DGM responses to ISOs are suitable surrogates for munitions for blind seeding purposes. Seed selection and placement will be conducted such that the ISO is placed a depth of 3x to 7x the diameter of the ISO to determine whether the DGM response is within the theoretical response curves for the least favorable orientation (LFO) and most favorable orientation (MFO). ISOs will be placed at a frequency of one per grid. The specific location of the items will be held in confidence from those evaluated for the detection and recovery of the seeds. Seed items will be painted and marked in such a manner as to readily identify the item as a QC- placed test or inspection item.

Following surface clearance and the layout of the grids, the UXO Quality Control Specialist (UXOQC) or his designee will place a minimum of one seed item per grid and record its location using a DGPS. The UXOQC will record in a seed tracking log the precise location, depth, and orientation of each seed item.

Failure to locate a seed item in any grid at a depth equal to or less than the detectable depth determined from the NRL theoretical response curves will signal process nonconformance and result in root-cause analysis, corrective action, and remapping/rework, dependent on the phase of failure. The UXOQC will account for and track the recovery of all seed items. No grid will pass QC prior to verifying the successful identification and recovery of its emplaced seed.

4.3 DATA COLLECTION PARAMETERS

Final data collection parameters will be determined based on the evaluation of the IVSdata.

These parameters include

- Lane spacing
- Data collection speed
- Data collection intervals

Orientation of lanes will be determined by the Field Team Leader (FTL) for each grid based on terrain and slope. The orientation will be recorded in the FTL logbook and on the Geophysical Field Sheet in Attachment 3.

5.0 EQUIPMENT AND PROCEDURES

5.1 EQUIPMENT

The following is a list of equipment that will be necessary to complete an EM61-MK2
DGM Survey with DGPS:

- EM61-MK2 geophysical sensor and data logger
- Appropriate signal and power cables
- GPS base station receiver, antenna, and associated equipment
- GPS rover receiver, data logger, antenna, memory card, and battery
- GPS cables
- Sufficient batteries for daily operation

The following additional equipment and forms will be assembled by the FTLs:

- Task-specific field data logbook
- Black-ink pens (indelible)
- Digital camera
- Inclinometer
- Personal protective clothing (as required by health and safety personnel)

5.2 GPS AND GEOPHYSICAL DATA COLLECTION P ROCEDURE

The following set of procedures is subdivided into procedures for the base station and procedures followed at each MRS. In addition; Attachment 1 provides step-by-step instructions for equipment operation.

5.2.1 GPS BASE STATION PROCEDURES

For initial GPS base station setup procedures, refer to SOP-605, Target Reacquisition.

1. Beginning of day:

- Activate the DGPS base station at its known location. Check transmission of signal at indicated transmission rate (modem LED).

2. End of day:

- Deactivate DGPS base station.

5.2.2 EACH MRS LOCATION

1. Mount the DGPS rover antenna on top of the top coil on the EM61-MK2. The antenna should be mounted and centered directly above the EM61-MK2 sensor for optimum positioning.
2. Check to ensure that the mode switch on the back is set to 4.
3. Check to ensure that the master/slave switch is set to m (master).
4. Activate the geophysical and DGPS rover units. Check that the Allegro "date/MK2a program survey" menu data acquisition mode is set to auto. Check that both units are collecting valid data (see Attachment 1).
5. Proceed with survey. Attempt to maintain a distance of 1 meter between the EM61-MK2 coils and the operator.
6. One member of the team will be responsible for maintaining the logbook. Record the following information in the logbook:
    - Grid ID
    - Time survey started
    - Time survey completed
    - Names of team members
    - Weather conditions
    - Serial numbers of DGPS rover unit and geophysical instrumentation
    - File names for the digitally recorded data. Each page of the logbook will be dated, sequentially numbered, and identified by the logbook number; all entries will be signed. The field team leader will place photocopies of the logbook pages in the appropriate folder located in the processing center at the end of each workday.
7. End of the day:
    - All equipment is returned to storage and the batteries are placed on charge.
    - The waypoint/track maps and logbook pages are photocopied and placed in the appropriate folder located in the processing center.
    - The data files are submitted to the processing center data manager.
    - The completed survey areas are recorded in the tracking log.

- The GPS positional track maps and logbook pages are accessible for periodic verification by CQC representatives.

5.2.3 GRID GEOPHYSICAL SURVEY

One hundred percent of accessible areas of the grids will be DGM surveyed. DGM survey teams will establish collection lanes using ropes placed in the across-track direction at intervals of 25-ft. Ropes will be marked with alternately colored paint marks on intervals dictated by the Lead Geophysist to enable straight line profiling.

Two types of data will be collected during the DGM surveys:

1. EM61-MK2 data with integrated DGPS coordinates
2. Digital photographs

The management and internal QC review procedures for each type of data are discussed in the following sections.

5.2.3.1 EM61-MK2 AND DGPS SURVEY DATA COLLECTION AND RECORDING

EM61-MK2 survey data include all electronic geophysical instrument data produced during the survey. DGPS survey data include all electronic positional data produced during the survey. Procedures for use of the EM61-MK2 and GPS units are provided in Attachment 1.

5.2.3.2 PHOTOGRAPHS

Digital photographs will be taken to document site conditions during DGM data collection. Each team will maintain a photo log in their field logbook. The date, time, and subject of each photograph will be recorded at the time the photograph is taken. The digital cameras and copies of the photo logs will be given daily to the DM for entry into the photo tracking form and upload to the project computer. Management of electronic files and QC requirements are detailed in SOP-604, Geophysical Data Processing.

5.2.3.3 INACCESSIBLE AREAS

The field team will document all inaccessible areas within each grid using the designations contained on Attachment 2. The field should note within the field book and on Attachment 3- Geophysical Grid Sheet all surface features that limit access to a portion of a grid. Cultural features (e.g., fences, buildings) and physical features (e.g., rock outcrops, boulders, ravines, ponds and swiftly moving water) may result in inaccessible areas. All inaccessible areas will be sketched on the team's grid sheet and denoted as to their source.

5.2.4 DEVIATION FROM LANE ORIENTATION AND SPACING

Deviation from geophysical survey lane spacing and orientation will be determined and documented in the field. The FTL will be responsible for determining whether an area is considered inaccessible due to site conditions. The FTL will designate one member of the team to document deviation from standard lane set-up due to terrain, slope,

or other conditions that make the area impassable by foot. Attachment 2 provides examples of such conditions and may be used in the field by the survey team to assist in documenting deviations. The following steps are recommended to perform lane deviation documentation:

- The FTL will designate one member of the team to perform documentation activities on a daily rotation schedule. The team member will be responsible for completion of the checklist, logbook entries, and photo documentation.
- Deviations will be tied to the planned grid. If deviation is necessary, a sketch of the grid will be denoted with the cause of the deviation.
- Other features such as rock out crops, boulders, crevasses, ponded water, and swiftly moving water may cause inaccessibility and result in additional sources of lane orientation and/or spacing deviations. Logbook deviation documentation will include:
    - Date
    - Time
    - Grid designation
    - Photo number
    - Photo description including orientation
    - Feature type and description
    - Reason for deviation (checklist)
    - A photographic record of the deviation will be generated by the documentation team member. A digital camera will be used to record a minimum of one photo of each deviation area. The photographs will be downloaded by data management personnel at the end of each day.
    - DGPS coordinates will be obtained at the beginning and the end of the deviation.

All documentation will be archived in the same manner as other survey documentation.

5.2.5 DAILY DATA MANAGEMENT

Several files are generated by the DGM and DGPS systems for each site surveyed. These data are stored on the data logger(s) and DGPS receiver during data acquisition activities. At the end of the day, the data collected by each field team will be merged and sent to the Senior Geophysicist via e-mail or a file transfer protocol (ftp) site. The following file types are generated for each survey.

- Geophysical data file with signal intensity and DGPS positioning coordinates
- Digital photo files (*.jpg)
- Geophysical Field Sheet

- Geophysical QC Checklist

6.0 QUALITY CONTROL/QUALITY ASSURANCE

A quality control (QC) checklist for DGM surveying can be found in Attachment 4. To maintain consistency, each geophysical instrument and DGPS unit used for field activities will be listed according to make, model, and serial number in the field logbook and in the digital data files. Checklists of equipment functional tests (Attachment 4) will be filled out on a daily basis and retained in the project files. In addition, test data will be stored on magnetic media or in field logbooks. Procedures for data tracking, media backup, and survey documentation can be found in SOP-604. Documentation of any geophysical instrument adjustments will be maintained in the project files.

Daily QC checks (see Attachment 4) will be performed prior to data collection and as noted below. A static and spike test will be performed each morning and afternoon. In addition, the IVS will be surveyed at the beginning and end of each day of data collection by each DGM field team.

Copies of the geophysical instrument manuals will be located in the on-site geophysical library in the project site office.

Static and Spike Test - The equipment will be located in a “quiet” area (area where there is no response to metal) and held stationary in this location for one minute to determine no metallic reading is recorded. A small “standard” metal object is introduced to the surface centered beneath the coils and data recorded for one minute (the same “standard” object is used each day).

The metal object is removed and data again recorded for one minute. The data from this activity will be evaluated during data processing to verify that the equipment was functioning properly.

A separate data collection file is used for this purpose and labeled with “QC” in place of the normal grid designation (see Attachment 1 for naming convention of files). This information is reviewed per the requirements of SOP-604, Geophysical Data Processing. In addition, field staff will check available readouts to verify that the equipment is physically functioning consistently.

IVS Test – The IVS will be re-run at the beginning and end of each day to document instrument functionality and to determine the instrument latency. The collection team traverses the center line of the IVS to ensure that the DGM sensor passes over each of the IVS seed items. A separate data collection file is used for this purpose and labeled with “IVSam” or “IVSpm” in place of the normal grid designation (see Attachment 1 for naming convention of files). This information is reviewed per the requirements of SOP-604, Geophysical Data Processing and Interpretation.

No calibration will be made to the instruments since they are calibrated before leaving the factory.

7.0 REFERENCES

ESTCP, 2009, Geophysical System Verification (GSV): A Physics-Based Alternative to Geophysical Prove-Outs for Munitions Response, July 2009.

NRL, 2009, NRL/MR/6110—09-9183, EM61-MK2 Response of Three Munitions Surrogates, March 12 2009.

ATTACHMENT 1

EM61-MK2 AND DGPS OPERATION

The following is a step-by-step instruction for data acquisition with an EM61 geophysical instrument coupled to a DGPS system. Although this SOP is specific with respect to the instrumentation, it may be used as a general guide for future field-oriented SOPs.

The following procedures are provided to assist in establishing a consistent data acquisition process. The procedures will be adhered to during data acquisition activities to ensure that the data collected are of sufficient quantity and quality to meet the program objectives. The Project Geophysicist is responsible for ensuring that these guidelines are followed, and that the data acquisition staff is adequately trained to operate the equipment.

Equipment Necessary

- DGPS receiver with memory card
- DGPS antenna, terminal, antenna cable, and terminal cable
- Two batteries in GPS unit and three extra batteries
- Appropriate battery chargers
- Extra antenna and terminal cable
- Plastic antenna pole
- Power bar and AC-to-DC cigarette lighter adapter
- EM61-MK2 coil and GPS mounting T-bar
- EM61-MK2 backpack with battery
- Black cable, orange computer logging cable
- Two extra batteries
- Data recording device with battery, two extra batteries, and charger
- One polycorder, orange polycorder cable, and orange polycorder dump cable (backup)
- Field logbook and “write in the rain” pens
- Safety glasses or goggles
- Communication radio
- Personal gear and supplies (leave metal and/or wallets in the office)

The following specific description may be slightly altered depending upon the specific data logging device used.

EM61 Ready

- Take the EM61-MK2 coil and backpack out of vehicle and connect via the black cable.
- Turn on the instrument via the switch on the backpack, ensure that the knobs on the backpack are set to “M” (Master) and “4” (4-channel).
- Ensure that the operator who will carry the EM61-MK2 coil has no metal on his/her person.

GPS Ready

- Position the GPS backpack against the EM61-MK2 coils so that the antenna is approximately vertical and pointing away from obstructions (includes the vehicle and personnel).
- If you have a problem with satellite acquisition (minimum of 5 necessary to start), tilt the antenna slightly towards the south.
- Assuming that the antenna/receiver cable is already attached, connect the terminal to the receiver via the gray cable; turn on the instrument with the terminal (on/off button).

Note: The Trimble DGPS unit will be pre-programmed to stream data upon power up.

This data is a National Marine Electronics Association (NMEA) GGA/GSA* stream which merges with the EM61 data and provides real-time coordinates on the anomaly readings.

* GGA/GSA represent references to the global positioning system fix data setup string which provide 30 location and accuracy data to the GPS output stream and the global satellite status. The detailing configuration string can be found at

www.gpsinformation.org/dale/nmea.htm#GGA.

EM61 and GPS Go

- Mount equipment (EM61-MK2 coil and GPS Antenna centered on top of the coil, EM61-MK2 backpack, and data recording device).
- Turn EM61-MK2 data recording device on.
- Enter DAT61 MK2a Program
- Allegro: Select Survey Setup.
- Mode=auto, readings/s=10, surv line=0 or n/a, line incr=1 or n/a, sequence=alternate or n/a, direction=north or n/a, start stn=0, stn incr=positive.
- Select System Setup.
- # of EM61s=1, sensor size=0.5 × 1 (1/2 meter), GPS antennae=0.25m (1/2 meter) or 0.5m (full meter), leading em=1, trailing em=1 or n/a, sensor sep=0.0, em61#1 port=com1.

(For analog mode during reacquisition and excavation confirmation, stop here)

- Select Logger Setup
- Check that the data logger has the correct data and time.
- Units=feet or n/a, dump port=com1 or n/a, audio=yes or n/a, pause key=any two keys BUT NOT any key, bar scale=compressed or n/a.
- Select GPS Input.
- GPS input=enabled, nmea data=gga, com port=com2, baud rate=9 600, parity=no, data bits=8, stop bits=1.
- Select Logging.
- Instrument is in monitoring mode; check GPS data (# satellites and make sure bar is moving on the Allegro to show that the GPS rover unit sending a signal to the Allegro) and EM61-MK2 data (coil values, battery).
- Null instrument in a "quiet" area. (A quiet area is found by moving the instrument over a 5 meter area and verifying the mV reading does not change.)
- Enter file name per the naming convention:

  MRSSGGGMMDDF, where

  MRSS is the MRS

  GGG is the grid number

  MMDD is the date, and

  F is the file sequence (1, 2, 3, …).

(e.g., UXO1A1010153 …….where UXO represents MRS UXO1, A10 is the grid number, 1015 is October 15, and 2 for the third file for that day.

- Number of readings per second (15). For this scope of work your walking velocity must not exceed ~ 3 to 4 feet per second. See performance measurement criteria in WS 12 of the MEC QAPP.
- Name of Allegro operator. Enter your three initials.
- Name of survey line (0, or any numeric)
- Line increment (1, or any numeric)
- Direction of line (N, or any letter)
- Start station (0, or any numeric)
- Increment + or – (+)
- Settings ok ? (Y)
- Hit the designated button in the logging menu to start logging data

- Notice that the number of readings recorded in the file can be seen on the screen, as well as the values for the EM61-MK2 coils and the EM61-MK2 battery level (if the reading at the start of a session is less than 12v then change batteries, if the battery reading at the end of the session is less than 10.8v, the last session must be repeated). The button indicated in the logging menu pauses recording (this button can be set in the logger setup menu), and the “s” key turns the sound off (turn it off to conserve battery power).
- To end the survey (or a file), hit F5 (or other key indicated in the logging menu) and then the “Esc” key and follow the on–screen directions.
- During the survey, check the GPS logging status as well as the EM61-MK2 recording status ~ 10 minutes to avoid rework.

ATTACHMENT 2
INACCESSIBLE AREAS DESIGNATIONS

Logbook /DGPS Code	Condition making Area Impassable on Foot	Description of Condition
SS	Steep Slope	Slope physically too steep to walk on safely while maintaining the EM61-MK2 in a horizontal position. Use this code for slopes running upward (ridges). List all other factors which apply from the code list (LR, DV, etc.).
CB	Cobbles or Boulders	Cobbles or boulders over 25 % or more of the surface (may combine with steep slope).
R	Rocky	Hard, rocky surface over 25 % or more of the surface; combined with slope makes the area impassable.
DV	Dense Vegetation	Thickness/height of vegetation prevent safe traverse or prevent operator from maintaining EM61 in a horizontal position. List all other factors which apply from the code list.
ST	Stream	Streams which cannot be crossed without submerging boot tops or safely while maintaining the EM61-MK2 in a horizontal position. List all other factors which apply from the code list (LR, DV, etc.).
WM	Wetlands/Marshes	Wetlands, marshes, ponds or lakes which prevent safe traverse or prevent operator from maintaining EM61-MK2 in a horizontal position. Includes areas which cannot be traversed without submerging boot tops.
RO	Rock Outcropping	Isolated rock outcropping which prevents traverse of an area.
CF	Cultural Feature	Cultural features such as fences or above-ground utilities preclude access to an area. List what the specific cultural feature is in addition to the CF code.

ATTACHMENT 3
GEOPHYSICAL FIELD SHEET

Field Data Sheet

☐QC Checked by:_____ ☐QA Checked by: _____
Date:_____
Date:_____

Project Name: **Project Location:**
Geophysical Contractor: **Design Center POC:**
Project Geophysicist: **Site FTL:**
Survey Area ID: _____ **Date:** _____ **Field Team:**_____
Survey Type: ☐Grid ☐Meandering Path ☐Transect ☐Other:_____
Coord. System: ☐UTM ☐State Plane NAD ____ ☐Local ☐Other:_____ **Units:**☐meters ☐feet

Terrain:
☐Level ☐Mod. ☐Steep
☐Rolling ☐Ruts ☐Gullies
☐Rocky ☐Swampy ☐Dangerous

Tree Cover: **Tree Height:**_____
☐None ☐Light ☐Med. ☐Thick

Brush:
☐None ☐Light ☐Med. ☐Thick

Weather:
☐Sunny ☐Cloudy ☐Drizzle ☐Rain ☐T-storms
☐Hail ☐Fog ☐Humid ☐Snow

Grid Corner Coordinates:

	UTM/State Plane	Local
SW	_____,_____	_____,_____
NW	_____,_____	_____,_____
NE	_____,_____	_____,_____
SE	_____,_____	_____,_____

	Start	End	File Name
Battery Voltage:	____	____	
Static Background Value:	____	____	_____,_____
Static Response Value:	____	____	_____,_____

Instrument Clock Drift: _____
Raw Data File Name: _____ **Repeat Data File Name:** _____
Geophysical Instrumentation: **Serial Number:**
Base Station: **Serial Number:**
Navigation Method: **Serial Number:**
Additional Comments: _____

Grid: _____

Sketch of Survey Area:

Approximate Scale:_____ **North Arrow:** _____

Additional Comments: _____

ATTACHMENT 4
DAILY GEOPHYSICAL QC CHECKLIST

PIKA/PIRNIE JV GEOPHYSICAL QC CHECKLIST

Project: _____ **Date: _____**

Equipment:_____ **Personnel:_____**

QC Tests	**Pass/Fail**
Equipment in working order	_____
Cable Shake	_____
Personnel	_____
Test AM	_____
Static	
AM	_____
IVS PM	_____
Static	_____
PM IVS	
Positioning Equipment Checked	_____
IVS Approved Personnel	_____
IVS Approved Equipment	_____
Ropes used for lane control	_____
SW corner used as start	_____
point Field Data Sheet	_____
filled out	

SOP 604: STANDARD OPERATING PROCEDURES FOR EM61-MK2 DGM DATA PROCESSING

Contents

ACRONYMS

DGM .....Digital Geophysical Mapping
DGPS .....Differential Global Positioning System
ftp .....file transfer protocol
FTL .....Field Team Leader
GIS .....Geographic Information Systems
GPS .....Global Positioning System
JV .....PIKA/PIRNIE Joint Venture
MEC.....Munitions and Explosives of Concern
QC.....Quality Control
SAP .....Sampling and Analysis Plan
SOP .....Standard Operating Procedure

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide PIKA International, Inc. (PIKA)/Malcolm Pirnie, Inc. (PIRNIE) Joint Venture (JV), LLC ("the JV") employees and subcontractors with the minimum procedures applicable to the processing of EM61-MK2 digital geophysical mapping (DGM) data collected on sites impacted by munitions and explosives of concern (MEC).

2.0 SCOPE

This procedure applies to EM61-MK2 data collected during DGM surveys using Differential Global Positioning System (DGPS) equipment. It applies to all aspects of geophysical data management and quality control (QC) from collection, through processing and analysis, to production of intrusive investigation packages and data transfer to the project database and geographic information system (GIS). The major elements of this procedure are electronic data transfer, data processing, data analysis and interpretation, data archiving, and data tracking.

3.0 MAINTENANCE

The Senior Geophysicist is responsible for the maintenance of this procedure and approving any changes to it.

4.0 TRAINING REQUIREMENTS

All site personnel involved with the project will attend a site-specific orientation. The purpose of this orientation will be to review site-specific and emergency response procedures. In addition to site- specific training, task-specific training will be given to personnel performing specific functions. The topics to be covered during the orientation and task-specific training are listed below. Course attendance sheets with attached curriculums will be used to document completion of each orientation session. Determination of the adequacy of the level of training of assigned staff is the responsibility of the PM.

Training sessions will be held prior to initiation of DGM surveys for all personnel responsible for data processing, interpretation, recording, maintaining, and reviewing data. Data requirements and data entry will be explained in detail. The presentations will include an overall discussion of the project database and how the data processing and interpretation tasks integrate into the overall program. Data processing and QC personnel will participate in a session and be required to process a sample data set from the Instrument Verification Strip (IVS). Training will also include data review and QC procedures listed in this SOP or the project MEC SAP. The Senior Geophysicist will be responsible for this training and any follow-up training deemed necessary.

5.0 PROCEDURES

The data processing, data analysis and interpretation, quality control reprocessing and quality assurance process steps must flow smoothly and clear communication must occur. The below sections outline the data processing flow for the project.

5.1 TRANSFER OF FIELD DATA AND DATA TRACKING

Several files are generated by the DGM and DGPS systems for each site surveyed. These data are stored on the data logger(s) and DGPS receiver during data acquisition activities. At the end of the day, the data collected by each field team will be sent to the Senior Geophysicist via e-mail or file transfer protocol (ftp).

The following file types are generated for each survey:

- measurements and DGPS positioning coordinates
- Digital photo files (*.jpg)
- DGPS raw data containing code and carrier phase data, position data, and site identification.

All EM61 data files will be electronically logged upon receipt. The following items will be recorded in an Excel spreadsheet or MS Access database for each EM61 file collected:

- MRS
- Grid, QC, or IVS, etc.
- DGM Team designator
- Date collected
- EM61 file name

RTK mode will be used. In this mode, EM61 and corrected position data are co-located in a single computer file. The GPS data for the receiver and base may be recorded, and post-processed, as necessary, to fill in position data at times where the GPS radio modems are not functioning.

The EM61 and DGPS data will be processed at a JV office. The following information will be tracked on the Excel spreadsheet or MS Access database:

- Date EM61 data processed
- Method and amount of latency correction
- Method and parameters of leveling correction
- Method and parameters for data gridded
- Method and cutoff for target selection

- Initials of processor
- Grid file name

After the data has been interpreted, the selected target anomalies will be added to the project database. The following information will be added to the Excel spreadsheet or MS Access database:

- Number of anomalies
- Date anomaly data added to project database.

5.2 GEOPHYSICAL DATA PRE-PROCESSING

The fundamental processing and analysis procedures function together as quantitative and intuitive processes. Quantitative processes are usually standard practices such as leveling corrections of EM61 data to remove instrument drift. These standard procedures can usually be rigidly formulated and automated for a specific objective. Other processes may be more intuitive in nature (e.g., correction for data "lag," analysis and correction of GPS outliers, comparison and reconciliation of data and "noise" characteristics, and design and implementation of GIS/database queries for prioritization of targets). These processes generally depend upon the experience of the personnel involved, especially their level of experience on MEC projects and their site specific experience.

The data processors will download the appropriate data files to their computers for processing and upload the resulting processed files back to the project server when processing is completed.

The data tracking sheet is reviewed for completeness by a data processor and the Senior Geophysicist on a daily basis.

DGPS position data are acquired at 1 to 2 Hz at both the base and rover units while the EM61 data are recorded at a minimum of 10 to 12 Hz by a Trimble data logger. The raw data is transferred to the project server. The data is collected in RTK mode, so the corrected position and EM61 data are co-located in one file.

Geonics DAT61MK2 software is used to convert the EM61 data to units of mV with a corresponding time stamp for each record. Data are corrected for "lag," a mode is automatically subtracted from each EM61 data channel, and positioning system "fliers" are corrected. The data are output as an ASCII file that contains the state plane coordinates of each measurement location (x,y,z), EM61 signal intensity for each time gate. The ASCII format file (*.XYZ) is the input for further processing in Geosoft Oasis Montaj v7.3 and the interpretation phase of the project.

The specific parameters used to process the EM61 and GPS data may vary; however, the processing parameters and results are documented in digital computer files so that the sequence of events can be reconstructed and analyzed at a later date, if necessary. This level of documentation assists in ensuring that the overall process is repeatable.

5.3 GEOPHYSICAL DATA ANALYSIS AND INTERPRETATION

Geophysical data interpretation parameters will be established from the IVS. Parameters may include anomaly response, selection threshold, signal to noise ratio, signal strength, response size and target size. Data will be interpreted using Geosoft Oasis montaj to provide coordinate location information for each target.

Color-coded images (maps) are generated from the DGM data to provide additional information on target location beyond that which is supplied in the dig list.

The primary interpreter (production) of the data will be a qualified geophysicist. As a QC measure, the Senior Geophysicist will review 100 percent of the first day's DGM data interpreted by the primary interpreter with step down QC in 50% increments. The specific data reviewed will be documented in the project database.

The data processor will generate color-coded images of the EM61 data for each grid. Potential target locations will be selected using a combination of two target selection methods; automatic and manual. The automatic method utilizes the Blakeley target selection algorithm within the Geosoft Oasis Montaj software. This procedure selects anomaly locations based solely on the signal intensity. The second method (herein referred to as "manual") utilizes a data interpreter who manually selects potential target locations using data characteristics such as the signal intensity from different time gates, anomaly footprint, anomaly shape and trend, track line characteristics (i.e., spatial sample density), terrain, previous intrusive information, the IVS results, and comments entered by the data acquisition crew regarding geology, terrain, weather, etc. The automatic target selector will select a pipeline, known cultural feature, or terrain-induced "noise" while the manual selection procedure generally will not. However, the automatic target selector prevents the interpreter from potentially "missing" an anomaly (i.e., it provides immediate feedback to the interpreter in the form of a QC check). The automatic target selector amplitude will be set to a value that is determined during analysis of the data from the IVS.

The interpreter will not attempt to differentiate MEC items from non-MEC items. If the interpreter selects any anomalies that may have a high probability of being an artifact of the data acquisition and/or data processing sequence, they will enter a comment in the interpretation file (e.g., cultural feature).

These anomalies will be reviewed a minimum of once per week, and if excessive "no finds" are reported by the intrusive team then only a percentage of these anomalies may be excavated during future intrusive activities.

5.3.1 DIG SHEET DEVELOPMENT

The interpreted targets are digitally recorded in a *.xlsx file, and uploaded to a Microsoft Access database. The dig sheet data for each survey grid will be organized by a unique

anomaly identifier for each target selection, its x-y coordinate location, signal intensity value(s) from the EM61, and dig priority.

Other pertinent information, such as estimated depth and relative anomaly size may be included, as necessary, if additional target analysis is performed in Geosoft's UX-Analyze extension.

5.3.2 INTERPRETATION SUMMARY

The objective of the interpretation is to select all of the legitimate targets caused by buried metallic items while minimizing the false alarm rate. For this project, the targets are primarily selected based on the anomaly footprint and shape, anomaly intensity for the different data channels, and information derived from previously-excavated targets. The interpreter will utilize information acquired from the IVS test to supplement target selection.

During intrusive investigation, a certain percentage of selected anomalies may turn out to be "no finds," targets for which no metallic items consistent with the geophysical data are found at the anomaly location. If directed by the Project Manager (PM), some or all of these anomalies will be reviewed by the Senior Geophysicist or their designee to determine the nature of their origin.

If they appear to be legitimate metallic targets rather than noise, the PM will be informed. If the "no find" target is determined to be an artifact of the data acquisition, processing, or interpretation processes, the specifics of the analysis will be noted in the project database so the interpreters can utilize this information during subsequent interpretation efforts.

5.4 DATA COLLECTION AND INTERPRETATION QC

The Senior Geophysicist is responsible for ensuring the geophysical QC program is implemented and adhered to. The QC procedures applied during the processing phase of the project are performed each day in the field to ensure the integrity of the data. Data that is not of sufficient quality and quantity to meet the project objectives is documented and recollected, if necessary.

Procedural checks during the pre-processing of the data include the following:

- Evaluation of the static position and EM61 data. EM61 static noise above a pre-defined threshold (tolerance ± 2 mV on channel 3) is documented and a root cause analysis performed prior to collecting additional data. A 2″ diameter bolt secured to a stake will be placed on the lower coil and used to perform this test.
- Evaluation of the IVS. These data allow the processor to qualitatively and quantitatively monitor the noise level and repeatability of the data over the IVS seed items, as well as ensure the data have been merged correctly using the time-stamp information (i.e., the data contain no time or position shift-also known as "lag")

- Interpreted corner stake locations (i.e., nails) for the grids are compared to known survey data and verified (tolerance ±2.5 foot)
- Down-line data density within grids are statistically assessed (> 95% of data has sample distances ≤ 0.6 foot for each grid).

The guidelines above are for geophysical data where the "background" is a prevalent data characteristic. In areas of high anomaly density (i.e., "cluttered" areas), the above guidelines may not apply.

The Senior Geophysicist will perform a data compliance check on, at a minimum, one morning and one after noon geophysical data file from each team. This compliance check will ensure data collection settings and basic GPS functionality. If he/she finds an issue that calls in question the validity of the data, the remainder of that teams data will be check. Any unacceptable data grids will be reported to the DGM field team leader (FTL) and the site superintendent. The effected grids will be marked for recollection. The Senior Geophysicist will record the result of this surveillance in his/her QC log book.

Quality control measures applied during the interpretation of the data are the following:

- Targets selected interactively by the user are compared to those selected automatically by UX Detect (Oasis Montaj). This process ensures that anomalies that meet a certain criteria for selection are not "missed" by the interpreter and thus included on the dig sheet.
- Grid corner nails are interpreted and some of these points may be reacquired by field personnel to verify accuracy (±2.5 feet) of the interpreted position coordinates
- Comparison of the position and EM61 data to the site features map (e.g., above-ground cultural features are documented-should be variance in track path)
- Interpreted data characteristics are compared to the known responses acquired during the initial test program (e.g., IVS).

5.5 INDEPENDENT GEOPHYSICAL QC PROCESSING

If a subcontractor collects and processes DGM data on a project, the JV will perform independent QC processing of the data in accordance with this section to verify the quality of the data. Once the initial geophysical anomaly analysis and interpretation is completed, the pre-processed data and initial dig sheet will be delivered to an independent QC team for QC reprocessing. This QC will be performed using the same procedures and the initial processing. The independent geophysicist will review 100 percent of the data interpreted by the primary interpreter with step down QC in 50% increments.

Once the independent analysis is performed, the anomaly selections will be compared to the initial dig sheets. The QC processors will add any additional picks to the dig list annotating them as 900 series picks. Any anomalies that are in question will be marked

for re-evaluation and in consultation with the Senior Geophysicist will be removed from dig list if appropriate. If the number of additions plus deletions are greater than ± 20 percent of the number of initial picks, the independent QC lead with work with the Senior Geophysicist to perform a root-cause analysis and implement corrective actions.

5.6 GOVERNMENT QA REVIEW

As the initial and QC dig sheet(s) are finalized, they will be sent to the Government's QA contractor for concurrence on the anomaly picks. If differences exist, a consensus will be developed and any additional picks identified in the QA review will be added to the dig sheet.

The final approved dig sheets will be forwarded to the Senior Geophysicist

If the Government QA identifies deficiencies in any data sets, the Senior Geophysicist will perform a root cause analysis and implement corrective actions.

5.7 GEOPHYSICAL DATA ARCHIVING

All geophysical data on the data management computer will be archived daily. The entire database and all associate data files will be copied to the project server, which is backed up daily.

All geophysical data will be stored on the JV's server located in the JV's secure server room. Geophysical data will be backed up using the JV's distributed daily/weekly back protocol. The JV's data security and disaster recovery plan has been reviewed and approved by the JV's Corporate Quality Manager and IT Manager and is available upon request.

ATTTACHMENT 1

DGM SURVEY DATA AND DIG SHEET

DGM Survey Data and Dig Sheet MEC RI, Twentynine Palms
Quality Control Checklist Grid: _____

Grid Size (ft.): _____ Non-DGM Sub-Areas: _____
Data Collection Days: _____ Saturated Response Areas: _____
Grid Hubs: Removal Area Boundary: _____

Raw Data QC:	Check all that Apply	Comments:
Data Coverage	☐	_____
AM/PM Static Test Results	☐	_____
Am/PM Replicate Line Results	☐	_____
Hub Detection	☐	_____

Grid DGM Survey:	Check all that Apply	Comments:
Data Tracks/Completeness	☐	_____
Non-DGM Sub-Areas Mapped and Labeled	☐	_____
Cultural Features Identified	☐	_____
Location Control	☐	_____
Background Levels	☐	_____
Noise/Interference Levels	☐	_____
Data Processing other than Level/Lag	☐	_____
Other DGM Survey Issues	☐	_____

Grid Review Map:	Check all that Apply	Comments:
Basemap Plotted	☐	_____
Standard Map Legend Format	☐	_____
Standard Scale/Color Bar	☐	_____
Cultural Features Mapped and Labeled	☐	_____
SRA/Non-DTM Areas Mapped/Labeled	☐	_____
State Plane NAD83 Coordinates	☐	_____
Grid Edge/Boundary Issues	☐	_____
Plotting/Labeling of Anomalies	☐	_____
Other Grid Mapping Issues	☐	_____

Raw Data Processing:	Check all that Apply	Comments:
Level (UX-Detect Drift)	☐	_____
Lag Correction (2 points)	☐	_____
Line/Data Editing	☐	_____
Grid Extraction (plus buffer)	☐	_____

Grid Target Selection:	Check all that Apply	Comments:
Initial UX-Detect Auto-Selection	☐	_____
QC Codes Assigned	☐	_____
Saturated Response Areas Mapped	☐	_____
Outside of Grid Targets Removed/Edge Issues	☐	_____
Notes on Individual Anomalies and/or Locations	☐	_____
Other Anomaly Selection issues	☐	_____
Targets Sorted by Amplitude	☐	_____
Placement of "Cut Line" (~3 mV)	☐	_____

Submittal Dig Sheet:	Check all that Apply	Comments:
Grid ID	☐	_____
Hubs and Hub Coordinates	☐	_____
Other Dig Sheet Header Information	☐	_____
Anomaly Identification	☐	_____
Anomaly Location	☐	_____
Anomaly Peak Amplitude	☐	_____
Cut Line Labeled	☐	_____
Non-DGM Sub-Area Clearance Approach	☐	_____
Other Dig Sheet Issues	☐	_____

Review Procedure	Date	Person Performing Task
Raw Data QC		
Grid DGM Survey		
Grid Review Map		
Raw Data Processing		
Grid Target Selection		

Submittal Dig Sheet Review and Posting		
QC Review		

Additional Notes on Processing Parameters:

SOP-605: STANDARD OPERATING PROCEDURES FOR DGM TARGET REACQUISITION

TABLE OF CONTENTS

ACRONYMS

DGPS .....Differential Global Positioning System
GPS .....Global Positioning System
HH.....Hand-held
JV .....PIKA/PIRNIE Joint Venture
MEC.....Munitions and Explosives of Concern
NW.....Northwest
QC.....Quality Control
QCM .....Quality Control Manager
SAP .....Sampling and Analysis Plan
SOP.....Standard Operating Procedure
SSHP.....Site Safety and Health Plan
UXO.....Unexploded Ordnance

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide PIKA International, Inc. (PIKA)/Malcolm Pirnie, Inc. (PIRNIE) Joint Venture (JV), LLC ("the JV") employees and subcontractors with the minimum procedures and safety and health requirements applicable to the conduct of digital geophysical mapping (DGM) target reacquisition on sites impacted by unexploded ordnance (UXO) or munitions and explosives of concern (MEC).

2.0 SCOPE

This SOP applies to all JV site personnel, including contractor and subcontractor personnel, involved in the conduct of DGM operations on a UXO/MEC contaminated site. The following JV policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with the project Work Plan, the MEC sampling and analysis plan (SAP), other JV SOPs, the Site Safety and Health Plan (SSHP), applicable Federal, State, and local regulations, and contract restrictions and guidance. Consult the documents listed in Section 5.0 of this SOP for additional compliance issues.

This SOP applies to the reacquisition of targets identified from the interpretation of DGM data. The data positions are derived from concatenated data from the Trimble differential global positioning system (DGPS) and the EM61-MK2. These guidelines will be used to locate targets identified as potential MEC through interpretation of the geophysical data. The major elements of this SOP are:

- System setup
- Navigation/occupation of desired coordinates
- Sensor interrogation
- Information recording
- Demarcation of coordinates
- Quality Control (QC)

The Senior Geophysicist is responsible for the maintenance of this SOP. Approval authority rests with a qualified geophysicist, the QC Manager (QCM), and the Army.

3.0 TRAINING REQUIREMENTS

All field personnel will meet the training requirements presented in SOP-601 and SOP-603. Additional training for the geophysics teams is summarized in this section. The topics to be covered are listed below. Attendance sheets with attached curriculums will be used to document completion of each orientation session.

Training Agenda

1. Project summary
2. SOP review
3. Approach and administrative review
4. Equipment training

The site-specific training will include step-by-step review of applicable SOPs to ensure that all reacquisition team members clearly understand the procedures for equipment operation, acquisition of targets in the field, and data recording.

All personnel assigned to reacquisition teams will require an initial certification in the IVS plot prior to conducting any fieldwork. Each team member must demonstrate the ability to perform assigned tasks associated with target reacquisition with the equipment at the approved IVS plot. This equipment includes:

- EM61-MK2 or EM61-MK2 hand-held (HH)
- Trimble DGPS with controller
- Allegro data logger

Methodology, data requirements, and the field documentation protocol will be explained in detail, and the certification training will also include an overall discussion of the project approach and how the reacquisition tasks integrate into the overall program. Additionally, the training will include review of the internal QC procedures for this task and project-reporting requirements. The Senior Geophysicist will be responsible for this training and any follow-up training deemed necessary. Certification of the training and IVS test plot target reacquisition performance will be maintained by the QCM in the Training Log.

4.0 EQUIPMENT AND PROCEDURES

4.1 EQUIPMENT COMPONENTS

A listing of the components of the three positioning systems and other required equipment is provided below.

Trimble Differential Global Positioning System

- Base and rover units with antennas and cables
- Base tripod
- Rover pole and backpack
- Main deep cycle battery
- Global Positioning System (GPS) (camcorder) batteries
- Carry case (or jacket pocket) for terminal
- 2-watt radio modem programmed as receiver
- Rubber duck or whip antenna with cable
- PCMCIA data card with targets

Other Equipment

- Geonics EM61-MK2 or EM61-MK2 HH
- Logbook
- Communication radio (2-way)
- Color-coded sensor map with dig sheet
- Trimble GPS/Data Controller
- Non-metallic pin flags or other means of demarcation
- Permanent marker (e.g., Sharpie)
- Clipboard
- Electrician's tape
- Plastic bags
- Non-sparking probe to pilot pin flags

4.2 GENERAL PROCEDURES

The general procedures for target reacquisition consist of system setup, navigation to desired coordinates, sensor interrogation and refinement of the target location, recording coordinate information, and quality control. Personnel who perform target reacquisition are responsible for understanding these procedures.

Reacquisition can be accomplished by either DGM Teams or UXO Teams (in concert with intrusive operations). Following completion of DGM operations, each available DGM Team will be assigned to reacquisition duties to expedite site work.

When reacquisition is accomplished by UXO Teams, each UXO team will be composed of up to 7 members: a UXO Team Leader (UXO Tech III), two 2-person dig sub-teams (UXO Tech II and UXO Tech I) and one 2-person reacquisition/dig sub-team (UXO Tech II and UXO Tech I).

This team of up to seven individuals will be overseen by a UXO Tech III and will simultaneously conduct target reacquisition and intrusive investigation. The sub-teams may periodically switch from reacquisition to investigation as the work load demands but all activities will be overseen by the UXO Tech III.

4.2.1 DGPS BASE SYSTEM SETUP

1. Turn on Survey controller. Go to File, Job, and name the job appropriately.
2. Go to the "Units" menu and set the units to what the particular job calls for (feet, meters, etc.)
3. Go to the "GPS" menu. Set the appropriate projection, and then select automatic zone selection if using UTM. Click on "Geoid Separation File" and load the appropriate separation file. If there is no Geoid Separation file, select "none". Once this is done, click the "OK" button.
4. Next, go to the Equipment menu. Pick the "Receiver Utilities" tab, and then select "Power on Receiver". Go to "Configure Rover" menu; the default settings should be fine, and should not need changing. Next, go to the "Ports" tab. Note which channel is selected (i.e., 20), and then click "OK".

5. Select the “Monitor/Skyplot” menu. Check to see if the controller is picking up satellites.
6. Select the “Equipment” menu. Select Configure Base, check everything (settings should not need to be changed), and once this is done select “OK”. Go to “Enter Grid system coordinates”, then go to “List” and load the corresponding control point. The latitude/longitude of the selected point should be displayed. For Reference Station ID, type “A” and then click “OK”. A display should pop up, stating “Base Configuration Successful, Save a File?”; select “Yes” (put in today’s date for the reference file name).
7. Perform a benchmark test as requirement by the MEC SAP.

4.2.2 ROVER DAILY DATA UPLOAD

1. On the touch screen of the Logger, select “Survey Controller” program. The connection should be made through Bluetooth. (If the connection is not automatic, press Configuration, Controller, Bluetooth. Choose the Rover by serial number found on the base of the Receiver, choose “No Laser”, “No Ascii” on the menu.) The satellite information and data should appear on the right side of the Controller screen.
2. Copy the data file (.csv) prepared for the teams daily activity and past the data file into the Right Side of the Controller Screen.
3. Delete the previous days controller files as necessary

4.2.3 ROVER SYSTEM STARTUP

1. Push the blue button on the Rover. All three of the indicator lights should be on and/or blinking to indicate that the rover has power, and is talking to the satellites and receiving a signal from the base radio. Refer to the Trimble user manual to troubleshoot setup and/or system errors.
2. Plug in the Survey Controller to the Rover.
3. After the survey is started, press “Survey”, “Stakeout”, “Points”. The screen will come up blank, so press the “Add” button at the bottom of the screen.
4. There will appear several choices depending on pre-set groups and filters, but we should have preloaded all points to be staked by job name = grid name. Select the grid Choose “All Points”.
5. The list will be shown in numerical order. One can then enter a desired stake point number manually, as if working from a map, or select “nearest” from the bottom of the screen. The unit will select the nearest point to the operator and show direction and distance to move. When the point is set, choose “Measure” and an as-built location will be recorded. The default description is the original point number, and can be left as such.
6. After the point is stored, the original staked number will be automatically removed from the list. As the points are competed, the operator will be left again with a blank screen.

7. To stake another grid, escape the main menu, choose “Survey” and “End Survey”. The controller will give the operator a choice to “Power Down Receiver”. Choose Yes if finished, or press No, if there are more grids to stake. From the main menu, choose “Files”, “Open Job” and pick the next Grid, and repeat the process.

4.2.4 NAVIGATION/OCCUPATION OF COORDINATES

1. Coordinates should be sorted to optimized reacquisition as much as possible.
2. Use instrument data and visual aids to interactively navigate to the approximate coordinates of the target. For relative or specialized coordinate systems, field personnel must understand the Cartesian Coordinate system.
3. Be precise when marking the target coordinates to ensure interpreted location is reacquired as accurately as possible.
4. Place DGPS over interpreted location (± 3 inch required accuracy), record these coordinates and add any comments.
5. Mark the interpreted location using a pin flag or other means of temporarily identifying the location.

4.2.5 SENSOR INTERROGATION

1. Interrogate interpreted location with reacquisition sensor (either EM61-MK2 or EM61-MK2 HH). In general, DO NOT search outside a 2.5 foot radius of the interpreted location for the primary target.
2. Move the reacquisition sensor back and forth over the anomaly, working in perpendicular directions, to identify the peak of the anomaly.
3. Mark the reacquired location(s).
4. If there is no positive instrument response, document and MARK ONLY THE INTERPRETED LOCATION and refer this to the Senior Geophysicist for further action. If after review by the Senior Geophysicist the location is determined to be a “no find”, it will be so recorded. If no finds are encountered at a rate greater than 10 percent, a root-cause analysis will performed and corrective measures implemented as necessary.
5. The reacquisition sub-team will only reacquire sufficient anomalies that an excavation sub-team can investigate in a two day period. If the reacquisition team consists of UXO technicians, the sub-team will fold back as an excavation sub-team once the daily reacquisition is complete and record the data associated with the excavations and grid statistics. If there is time remaining, they will assist in excavation.

4.2.6 DEMARCATION OF COORDINATES

1. Mark the primary reacquired location with a non-metallic pin flag or other approved means.
2. Ensure that the marker (i.e., pin flag) is pushed into the ground at least 3 to 4 inches. On hard surfaces, use another pre-approved method.

3. Ensure that the target identification (ID) number from the database is written on the pin flag. Each marked location within the grid requires a UNIQUE number.
4. Continue to the next interpreted location.

5.0 QUALITY CONTROL

Quality control checks are documented in the sections above. Important checks include ensuring that the positioning information and the sensor responses are valid and repeatable. In addition to the daily positional accuracy tests, all daily EM61-MK2 tests (including the IVS test) are recorded and maintained on the server.

SOP-607: STANDARD OPERATING PROCEDURES FOR INTRUSIVE INVESTIGATIONS

Contents

ACRONYMS

bgs .....below ground surface
BIP .....blow in place
DGM .....Digital Geophysical Mapping
DGPS .....Differential Global Positioning System
EP .....Engineering Pamphlet
ESQD .....Explosive Safety Quantity Distance
EQ .....Exclusion Zone
Ft .....feet
IVS .....Instrument Verification Strip
MD .....Munitions Debris
MDAS .....Material Documented as Safe
MEC .....Munitions and Explosives of Concern
MGFD .....Munition with the Greatest Fragmentation Distance
MHE.....Mechanical Handling Equipment
MPPEH .....Material Potentially Presenting an Explosive Hazard
MSD.....Minimum Separation Distance
OE .....Ordnance and Explosive
PLS.....Professionally Licensed Surveyor
PVC.....Polyvinylchloride
RTK.....Real-time kinematic
SOP .....Standard Operating Procedure
SSHP .....Site Safety and Health Plan
SUXOS .....Senior UXO Supervisor
UXO.....Unexploded Ordnance
UXO I.....UXO Technician 1
UXO II .....UXO Technician 2
UXO III.....UXO Technician 3
UXOSO.....UXO Safety Officer
UXOQCS…...UXO Quality Control Specialist

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide all PIKA International, Inc. (PIKA)/Malcolm Pirnie, Inc. (PIRNIE) Joint Venture (JV), LLC ("the JV") employees and subcontractors with the minimum procedures and safety and health requirements applicable to the conduct of digital geophysical mapping (DGM) anomaly investigation operations on sites with unexploded ordnance (UXO) or munitions and explosives of concern (MEC).

2.0 SCOPE

This SOP applies to all JV site personnel, including contractor and subcontractor personnel, involved in the conduct of DGM operations on a UXO/MEC site. The following JV policies and procedures are not all inclusive nor are they applicable in all situations. This SOP is not a stand-alone document and is to be used together with the project Work Plan, the MEC Sampling and Analysis Plan (SAP), other JV SOPs, the JV Site Safety and Health Plan (SSHP), applicable Federal, State, and local regulations, and contract restrictions and guidance. Consult the documents listed in Section 5.0 of this SOP for additional compliance issues.

3.0 INTRUSIVE INVESTIGATION OPERATIONS

All intrusive operations at MEC sites will be under the supervision of UXO qualified personnel. Non-UXO qualified personnel will not be allowed in the exclusion zone (EZ) during intrusive operations. The EZ will encompass an area large enough to protect personnel from fragmentation by an unplanned detonation. In addition, if non-UXO qualified personnel require access to the EZ, all work will stop while they are in the EZ. During operations, JV personnel will strictly adhere to the SSHP and the following general safety practices:

- Operations will be conducted during daylight hours only.
- Access to operating areas will be limited to only those personnel necessary to accomplish the specific operation.
- UXO will only be handled by qualified UXO Technicians.
- During UXO operations the minimum separation distance (MSD) between UXO and non-UXO operations is the munition with the greatest fragmentation distance (MGFD), as stated in the Explosive Site Plan.
- During demolition operations personnel remaining on site will be limited to those personnel needed to safely and efficiently prepare the item/s for destruction.
- All personnel will attend the daily safety briefing (tailgate safety briefing) prior to entering the operating area.
- Anyone can stop operations for an unsafe act or situation.

- Safety violations and/or unsafe acts will be immediately reported to the UXO Safety Officer (UXOSO).
- Failure to comply with safety rules/procedures may result in termination of employment.

3.1 DETECTION AND REMOVAL PROCEDURES

3.1.1 GRID LAYOUT

A professionally licensed surveyor (PLS) licensed in the state of New Mexico will survey each of the clearance areas, accompanied by a UXO escort. Surveying activities will consist of locating clearance area boundaries, establishing permanent survey monuments, and establishing grids for geophysical investigation activities within the clearance areas (if a gridded survey is selected). The PLS will establish the grid corners for the 100 feet (ft) x 100 ft grids, that will be DGM surveyed. Dig sheets will be developed that prioritize the anomalies selected from the DGM data. These prioritized anomalies will be re-acquired to an exact location using the highly accurate Real Time Kinematic-Differential Global Positioning System (RTK- DGPS) and a Schonstedt GA-52CX magnetometer.

3.1.2 ANOMALY REACQUISITION AND MARKING

The DGM personnel will reacquire all geophysical anomalies identified for excavation on the tracking sheets. Using a polyvinylchloride (PVC) flag with the unique identifier number recorded in indelible ink, the actual field location of each reacquired anomaly shown on the tracking sheet will be flagged. Such reacquisition will be carried out concurrently with other site activities, taking into account proper EZ requirements related to adjoining work and off-site personnel.

3.1.3 INTRUSIVE INVESTIGATION OF ANOMALIES

3.1.3.1 Intrusive Teams

Intrusive investigation teams usually consist of a Team Leader (UXO Technician III) and at least one UXO Technician II or I, plus the Senior UXO Supervisor (SUXOS), UXO Quality Control Specialist (UXOQC), and UXO Safety Officer (UXOSO). During intrusive operations, UXO Technicians I will operate under the supervision of UXO Technicians II or III. Only qualified UXO technicians will perform UXO operations, which are defined as:

- MEC identification
- Access procedures such as excavation, either by hand or using heavy equipment
- Handling of MEC, explosives, or explosive items, and
- Disposal, including movement, transportation, and final disposal of MEC.

The UXO Team will be assigned a set of anomalies. Using the Dig Sheets provided, the dig team(s) will excavate each of the selected target anomalies. Site-specific conditions (e.g., a larger ordnance item found than was anticipated) may warrant modification of the

EZ/MSD and removal procedures described herein. As necessary, any changes will be prepared and submitted separately for approval prior to initiation of further activities on site.

3.1.3.2 Manual Excavations

Excavations for individual anomalies will be conducted using Schonstedt GA-52CX (ferrous metal) and/or White's XLT or Minelab's Explorer II (all metals) detector to assist the team in determining the location and orientation of the target item. The personnel excavating an anomaly shall initially remove no more than a 6-inch layer of soil at the location of the anomaly. A visual and electronic search of the excavation shall then be made. This process shall be repeated until the audible signal from the magnetometer indicates the object is close to the surface. Once this determination has been made, soil will be removed by hand until the source of the anomaly is located. Excavations on individual anomalies greater than 4 ft below the ground surface (bgs) will not be made without prior approval of the U.S. Army Corps of Engineers (USACE) OE Safety Specialist.

3.1.3.3 Mechanical Handling Equipment

Mechanical handling equipment (MHE) may be used to excavate large anomalies (e.g., pits) or those deeper than 4 ft bgs if required (e.g., to confirm the anomaly is not a MEC). Any decision to use mechanized equipment to excavate these anomalies will be made by the Senior UXO Supervisor (SUXOS) and the USACE OE Safety Specialist. Excavations will proceed slowly to ensure the MHE does not broach the item. If the excavated material is considered to be an MEC, it shall be uncovered sufficiently by hand to obtain a positive identification of the item. If the item is identified as UXO/MEC, a determination will subsequently be made as to whether it is fuzed or not.
While excavating with MHE, a UXO technician will be stationed in a position that is out of the reach of the excavation equipment but affords a view of the excavation site. This observer will ensure that the next lift is visually free of UXO. The excavated material will be placed onto the ground within a screening area that has been surface swept and the boundaries recorded. The soil spoils will be spread across the screening area using the excavator bucket. The excavated material will be screened for range related debris, material potentially presenting an explosive hazard (MPPEH), munitions debris (MD), and UXO/MEC items. UXO technicians will recover all pieces of munitions debris or range related debris and any ordnance items. After screening, the soil spoils will be stockpiled to the side of the screening area.

3.1.3.4 Disposal Pits

Excavations for disposal pits using MHE will be performed in a similar manner as specified in Section 3.1.3.2. However, because individual anomalies cannot be discerned within the disposal pits, material from the disposal pit will be excavated carefully in 2-foot lifts.

3.2 ANOMALY EXCAVATION REPORTING

The MEC Subcontractor will excavate and identify the sources of the reacquired anomalies in the field. Data to be recorded for each item discovered during anomaly excavation will include the following (as applicable):

- Type (e.g., MD, MPPEH, MEC, and UXO)
- Description (e.g., “20mm projectile, MK105 practice bomb, 40mm hand grenade” and “base, coupling, firing device”)
- Initial Condition (e.g., expended, inert, live, and to be determined [TBD])
- Approximate length
- Approximate width
- Depth
- Approximate weight
- Approximate inclination (per Figure 1-1)
- Approximate orientation (Azimuth per Figure 1-1)
- Approximate distance from flag
- Approximate orientation from flag
- Found in a pit?
- Piece of fragmentation?
    - Initial disposition (e.g., left in place or removed to scrap pile)
    - Requires demolition?

All data will be turned into the Site Geophysicist at the end of the day.

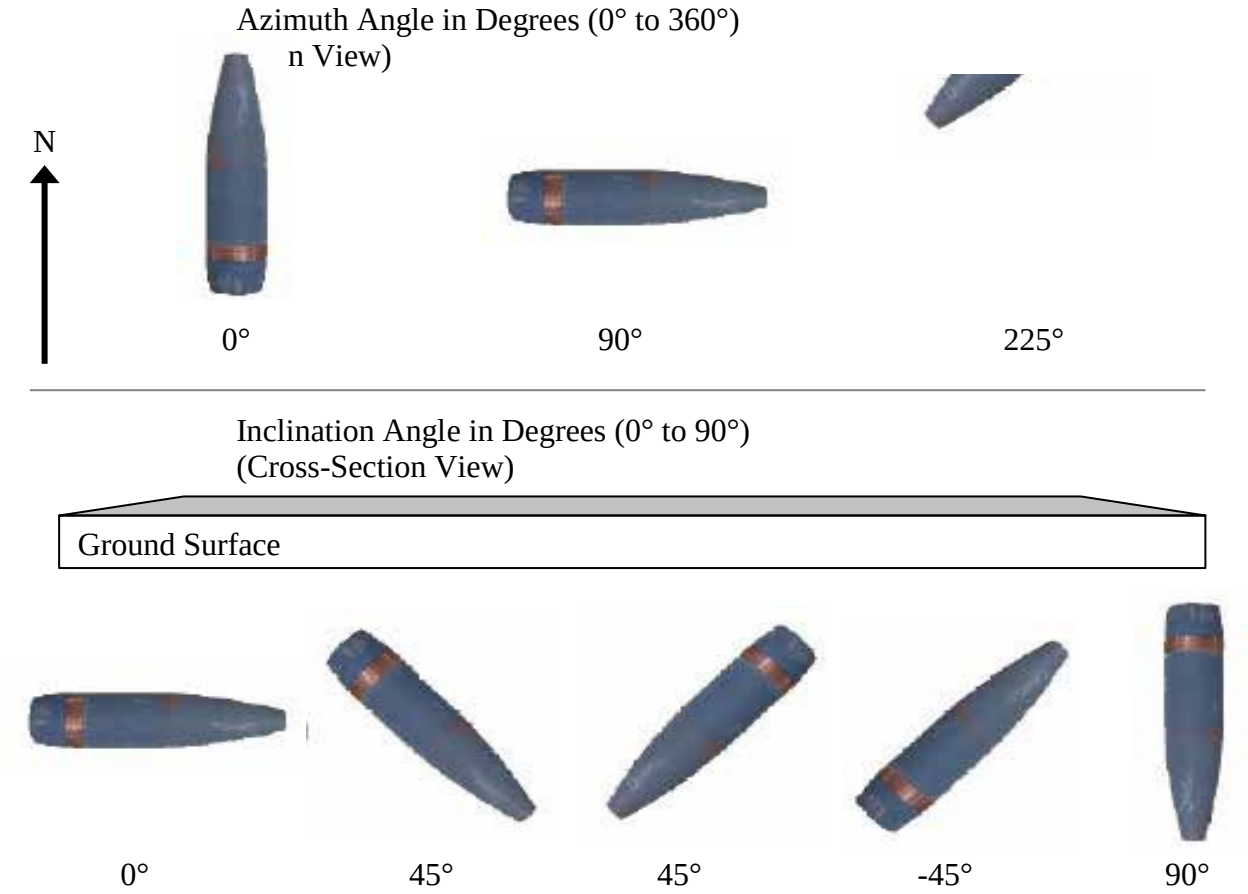


Figure 1: Azimuth and Inclination Examples

4.0 DISPOSAL OPERATIONS

See SOP-207 for detailed description of disposal operation.

5.0 REFERENCES

- USACE Safety Considerations for UXO/MEC
- USAE Corporate Safety and Health Program (CSHP)
- OSHA, 29 CFR 1910, Occupational Safety and Health Standards
- OSHA, 29 CFR 1926, Construction Standards

- Applicable sections of EPA, 40 CFR Parts 260 to 299, Protection of Environment
- Applicable sections of DOT, 49 CFR Parts 100 to 199, Transportation
- USACE EM 385-1-1, Safety and Health Requirements Manual
- USACE ER 385-1-92, Safety and Occupational Health Document Requirements for Hazardous Waste Remedial Actions
- DOD 4145.26-M, Contractors' Safety Manual for Ammunition and Explosives
- DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards
- DOD 4160.21-M, Defense Reutilization and Marketing Manual
- DA PAM 385-64, Ammunition and Explosives Safety Standards
- AR 385-64, Ammunition and Explosives Safety Standards
- AR 200-1, Environmental Protection and Enhancement
- AR 385-10, The Army Safety Program
- AR 385-16, System Safety Engineering and Management
- AR 385-40 w/USACE supplement, Accident Reporting and Records
- TM 9-1300-200, Ammunition General
- TM 9-1300-214, Military Explosives
- TM 60 Series Publications

APPENDIX C
LOCAL POINTS OF CONTACT

Appendix C

LOCAL POINTS OF CONTACT

Name	Role	Contact Information
Fort Wingate Depot Activity		
Richard Cruz	FWDA Caretaker	(505) 862-2416 Richard.cruz2@us.army.mil
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Jackie Smith	Lead OESS	(817) 821-2118 jackie.g.smith@usace.army.mil
PIKA-Pirnie Joint Venture (JV)		
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Paul Hanneman	Technical Lead	(303) 770-1501 (office) (303) 748-7881 (mobile) phanneman@pikainc.com
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Steve Stacy	Senior Geophysicist	(703) 465-4234 Steve.Stacy@arcadis-us.com
Dewey Thedford	Site Manager	(281) 914-2927 (mobile)
Emergency Contacts		
Richard Cruz Shannon Jackson	FWDA Caretaker IOSC	(505)862-2416 (575)520-2194

APPENDIX D

ACCIDENT PREVENTION PLAN / SITE SAFETY AND HEALTH PLAN

(Appendix D is included in electronic-only format on the enclosed compact disc)

APPENDIX E

SWMU 10 EXPLOSIVES SAFETY SUBMISSION

(Appendix E will be submitted with the Final WP as it has been submitted for approval under separate cover)

APPENDIX F

SWMU 40 EXPLOSIVES SITE PLAN

(Appendix F will be submitted with the Final WP as it has been submitted for approval under separate cover)

APPENDIX G
QUALITY CONTROL PLAN

1.0 GEOPHYSICAL QUALITY CONTROL PLAN

1.1 OVERVIEW

The Army's QC process provides a documented permanent and workable system that allows each employee to understand the job performance and results expected. Training required to do the job according to the requirements is provided as well. Checklists have been developed to ensure that critical elements are addressed and QC checks are documented. By promoting teamwork and focusing attention on solutions, the quality of work can be increased and assured throughout the project. This QC Plan provides the procedures and methods that will be used during the project. This plan addresses organization and responsibilities, equipment testing, functional checks, calibration, QC inspections and audits, and reporting procedures. In addition, checklists are provided to address each task.

1.2 PERSONNEL RESPONSIBILITIES

The Army's staff of experienced technical professionals will execute the project. Project personnel will be responsible for ensuring that quality methods and procedures are implemented. The quality management structure and specific quality duties are detailed in the following subsections.

1.2.1 Project Manager

The Project Manager is responsible for all aspects of the project including the quality of all products and services provided as part of this project. The PM will ensure that all deliverables satisfy project requirements and are conducted in accordance with the work plan. The PM will:

- Maintains the nonconformance, corrective and preventive action systems;
- Respond to QC inspections;
- Coordinate improvements to the QC plan based on suitability reviews;
- Obtain and communicates client requirements to the appropriate personnel;
- Ensure that qualified, skilled and trained personnel and other resources are available to implement the QC plan;
- Ensure that products and services satisfy client requirements including quality, safety, cost, schedule, performance, reliability, durability, accuracy and maintainability; and
- Ensure that personnel comply with applicable standards, regulations, specifications and documentation procedures.

1.2.2 Senior Geophysicist

The Senior Geophysicist, is responsible for ensuring the soundness of geophysical plans, the quality of geophysical data collection, processing and anomaly selection. The Senior Geophysicist, fulfills the following duties:

- Verifies that the data is of acceptable quality prior to submittal to USACE. He will also review QC results, review field notes, verify all daily field tests pass. If any of the above fails, the field crew and/or processors are notified and a solution is implemented.
- Resolves issues related to the quality of geophysical data.

- Knowledgeable of QC data requirements and ensures they are implemented correctly. Develops survey/test designs that will accomplish these goals, while also providing education and guidance to the field crews and processors as to the latest requirements.

1.2.3 Senior Unexploded Ordnance Supervisor

The SUXOS, is responsible for the day-to-day on-site management of UXO services. His responsibilities include direction of all UXO site operations and coordination with the Army UXOSO and UXOQCS. Additionally, the SUXOS is responsible for ensuring that field personnel are properly trained and indoctrinated, and that they have the necessary experience and skills to perform the assigned task. He is authorized to stop work in progress or make appropriate notifications when unsafe conditions exist or requirements are not being met.

1.2.4 Unexploded Ordnance Quality Control Specialist

The UXOQCS, reports independently to the Corporate Quality Manager on quality-related matters. The UXOQCS is responsible for monitoring site activities affecting quality, including MEC investigations activities, and for ensuring that these activities are being carried out IAW established requirements and protocols. The UXOQCS is responsible for conducting QC inspections of intrusive and explosives operations for compliance with the established procedures. He also fulfills the following duties:

- Contributes to the QC plan;
- Implements the QC plan in the field; and
- Conducts QC field inspections.

1.2.5 Project Quality Manager

The Project Quality Manager, is responsible for implementation of the QC Plan and UFP-QAPP. He will review field reports/logs and project deliverables, and verify correction of non-conforming work, in consultation with the Army PM.

1.3 Subcontractor Corrective Action

The JVs subcontract documents require subcontractors to promptly identify, report, and correct any conditions adverse to quality or safety. All personnel are authorized to stop work immediately for situations indicating imminent danger to personnel or property. Budget and schedule considerations will not override safety.

- Once an adverse safety or quality condition is identified, documentation of the cause and corrective actions to preclude reoccurrence are required. Subcontract agreements specify procedures for reporting significant conditions adverse to safety, health and quality.
- If a subcontractor problem is identified, the subcontractor will identify in writing to the Army PM a disciplined approach to solve the problem. Minimum procedures for corrective action include:
- Effective handling of client and/or the Army complaints;
- Investigation of the cause of the problem relating to work effort and quality system checks and forward a record of the results of the investigation;
- Determine the corrective action needed to eliminate the problem;

- Application of controls to ensure that corrective action is taken and that it is effective. Any corrective action taken to eliminate the causes of actual or potential problems will be appropriate to the magnitude of problems and commensurate with the risks encountered.

1.4 QC PROCEDURES

1.4.1 Overview

The Army will conduct site-specific employee training prior to the start of operations and supplement this initial training, as necessary, throughout the project. At a minimum, personnel will have:

- OSHA: Current certification IAW 29 CFR 1910.120(e);
- Safety: Review of the SSHP;
- Equipment Operator Training: Tailored to operator experience level and project objectives; and
- Daily Safety Training: Tailgate briefings outlining the day's activities, unique hazards and safety precautions, and other operational issues related to the project.

QC checks of every aspect of work are conducted routinely. The procedures will be used for all phases of fieldwork. The UXOQCS reports directly to the Corporate Quality Manager. QC processes and procedures are associated with personnel, data collection/analysis, instruments/sensors and other equipment, data deliverables and for measuring the effectiveness of MEC removal actions. The QC processes provide for:

- Testing and calibrating equipment used to perform work,
- Monitoring/measuring the effectiveness of work performed,
- Inspecting the maintenance and accuracy of site records,
- Determining compliance with site safety, environmental, and operational plans,
- Ensuring the accuracy, timeliness, and completeness of data deliverables, and
- Placement of a blind seed item (BSIs) to verify positioning control and detection.

Work progress and field data will be presented in weekly and monthly progress reports with accompanying maps, applicable DIDs, QC Plan, and specific requirements of the PWS. The Army will maintain a project GIS database. The GIS database will be updated daily during field activities and current maps will be provided with the weekly progress report. The JV will apply the OE GIS standard for the creation of datasets that identify grid/transect coordinates and identification numbers, dates of field activities, dates of QC and QA inspections, and locations that contain MEC, MPPEH/MD, and/or UXO. Additionally, geophysical and GPS-related QC test results will be documented in the Microsoft Access (DID Access) Database.

1.4.2 Quality Control Summary

Each definable feature of work will be monitored and documented, either in a bound field logbook, on prescribed forms (*i.e.*, dig sheets), or digitally in a Personal Digital Assistant (PDA). Non-conformance reports will be issued when an activity is not performed in accordance with the Work Plan or when results are not within a specified tolerance. In these situations, the PM and QC personnel will conduct a root cause analysis and develop a corrective measure for implementation. Acceptable tolerances may be

adjusted based on the outcome of the QC process and unexpected field conditions. These "adjustments" will be submitted to the USACE for concurrence, and documented, as necessary on a Field Change Request.

1.4.3 Quality Control Inspection

QC inspections may be performed periodically to ensure systems are functioning as planned. By or under direction of the Corporate Quality Manager, management surveillance of the QC program ensures that operations are performed in accordance with the work plan. The inspections include a review of procedures, logs, records, etc. Management reviews help determine discrepancies in information collected or if conditions and practices create the potential for QC problems, so that corrections can be implemented before problems occur.

Listed below are QC processes and procedures associated with personnel, data collection/analysis, instruments/sensors and other equipment, data deliverables, and for measuring the effectiveness of MEC investigations. The QC processes provide for:

- Testing and calibrating equipment used to perform work;
- Each geophysical component will be noted according to make, model, and serial number in the field logbooks and/or in the digital data logger for the respective instruments;
- Functional instrument tests for the system will be digitally recorded and available for review by QA personnel;
- All instruments and equipment that require calibration will be checked prior to the start of each workday;
- Batteries will be replaced as needed, and the instruments will be checked against a known source;
- Instrument-specific functional testing procedures will be performed in accordance with Instrument Standardization Quality Control Requirements methods;
- QC procedures will be implemented to ensure data acquisition, data processing, and interpretation methods are monitored at a sufficient level to meet the overall program objectives;
- Monitoring/measuring the effectiveness of work performed;
- The UXOQCS is responsible for ensuring that personnel accomplish all QC checks and that the appropriate log entries are made. The UXOQCS performs random, unscheduled checks to ensure that personnel accomplish all work specified in the Work Plan and submits a report of their findings to the SUXOS and the Corporate QC Manager;
- QC Journals and digital dig sheet data will be submitted to the SUXOS on a daily basis. These records include descriptions of the areas checked and the results of the QC checks. Non-conformance reports will be submitted to the PM and Corporate Quality Manager. Records of these daily inspections will be consolidated and submitted at the end of the project.

1.4.4 Geophysical QC Procedures

The Senior Geophysicist is responsible for implementing the QC program in accordance with this Work Plan, DID WERS-004.01, and the SOPs contained in Appendix B of this Work Plan to ensure that data quality is sufficient to meet the projects DQO requirements.

Components of the QC program include the following instrument checks to ensure that geophysical investigation management quality objectives (MQOs) are met. MQOs are listed in **Tables** 1-1 through 1-3, and include:

- Morning and Afternoon Static Checks for
  - Background
  - Spike (response to small ISO)
  - Return to Background
- Cable Shake
- Personnel Check
- Morning Real Time Kinematic (RTK) Differential Global Positioning System (DGPS) Reoccupation Check

Each of the instrument checks is outlined in detail within SOP-603 included in Appendix B. These measures will be reviewed regarding their project-specific implementation, metrics, and frequency. The Senior Geophysicist will process and analyze these instrument checks and records the results, comparing results with required project performance metrics. Results that fail to meet project requirements are flagged and reported to the Senior Geophysicist. A root cause analysis will be performed and a corrective action will be implemented. Instrument checks are repeated to confirm that the corrective action returned the equipment to acceptable performance.

In addition to the instrument standardization QC checks, the Army will perform daily QC audits of the field geophysical team to ensure overall project DQOs are being met. The instrument QC tests will be performed and documented by the designated individual during the data collection process and reviewed by a qualified geophysicist. All documentation will be submitted to the Senior Geophysicist.

All geophysical instruments and equipment used to gather and generate field data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Calibration, repair, or replacement records will be filed and maintained by the site geophysicist and may be subject to audit by the Senior Geophysicist.

The Senior Geophysicist will also determine whether the data meets the minimum performance requirements, as listed in **Tables** 1-1 through 1-3. Failure to meet the minimum performance requirements will require either corrective measures or re-collection of the failed dataset.

Other QC functions performed by the Senior Geophysicist include:

- Monitor that all Instrument Check results and DGM performance metrics are being maintained,
- DGM data deliverables are being made in accepted formats and on schedule, and
- Participate in any/all Root Cause Analysis, if any failure is identified, and the implementation of any corrective actions.

The Army is responsible for QA conducted on this project. This includes implementation of an internal quality program, such as insuring acceptable documents are submitted and the project is progressing in a manner to achieve milestones. QA may also be completed during the field work effort.

Digital Geophysical Data Process Modification

The Senior Geophysicist will document whether collection or interpretation processes need to be modified, if corrective actions are necessary, or if the processes are being performed to their optimal capabilities. If it is found that the interpretation processes need modifying or corrective actions are identified data processed previously will be reevaluated under new guidelines to correct deficiencies.

Table 1-1: DGM Performance Metrics for SWMU 10 Removal Action

Requirement	Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure
Static repeatability (instrument functionality)	All	Response (mean static spike minus mean static background) within error budget of predicted response(1)	Twice daily (beginning and end of each day)	Lot submittal fails.
Along-line measurement spacing	DGM grid surveys	98% <= 25 cm along line	By dataset	Dataset submittal fails.
Speed	DGM Grid Surveys	95% < 4 mph	By dataset	Dataset submittal fails unless new maximum speed successfully demonstrated at IVS.
Coverage	DGM Grid Surveys	> 90% coverage at project design line spacing (2.5-ft) and 98% coverage at 1 meter line spacing	By dataset or grid	Submittal fails unless gaps filled, additional data collected, or government refund for missing acreage.
Dynamic detection repeatability (IVS and Geophysical Systems Verification [GSV] blind seeding)	IVS (for DGM Grid Surveys only)	Peak response repeatable to +/- 25% of expected response	Twice daily.	Lot submittal fails.
	Blind Seeds (applies to DGM Grid Surveys only)	Peak response > 75% of minimum expected response	1 per day per team based on expected production rate	Lot submittal fails.
Dynamic positioning repeatability (IVS and GSV blind	IVS (for DGM Grid Surveys only)	Position offset of seed item targets <= 25 cm	Twice daily	Lot submittal fails.
	Blind Seeds (applies to DGM Grid Surveys only)	90% positioning offset is <= 0.63 m (25 cm + ½ line spacing) and 100% is <=0.731 m (35cm	1 per day per team based on expected	Lot submittal fails.

Requirement	Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure
seeding)		+ ½ line spacing) for digital positioning systems	production rate	
Target selection	All	All dig list targets are selected according to project design	By grid	Submittal fails.
Anomaly resolution	Verification checking with EM61-MK2 to verify response within anomaly footprint after excavation is less than the anomaly selection threshold.	·90% confidence < 1% unresolved anomalies. Accept on zero.	Rate varies depending on lot size (See Acceptance Sampling Table in DID WERS-004.01). Lot size is listed in the work plan.	Lot submittal fails.
Geodetic equipment functionality	All	Position offset of known/temporary control point within 10 cm.	Daily	Redo affected work or reprocess affected data.
Geodetic accuracy	Points used for RTK base stations	Project network tied to HARN, CORS, OPUS or other recognized network. Project control points that are used more than once must be repeatable to within 10 cm.	Repeat occupation of each point used monthly.	Reset points not located at original locations or resurvey point following approved Work plan
Geodetic repeatability	Grid corners/transect points	Measured locations are reoccupied within 10 cm.	1 per lot	Lot submittal fails.

Notes:

1. **The predicted response and error budget will be calculated on the first day on site prior to conducting anomaly reacquisition.**

Table 1-2: DGM Performance Metrics for SWMU 40 Investigation

Requirement	Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure
Static repeatability (instrument functionality)	All	Response (mean static spike minus mean static background) within error budget of predicted response(1)	Twice daily (beginning and end of each day)	Lot submittal fails.
Target selection	All	All dig list targets are selected according to project design	By grid/transect or dataset	Submittal fails.
Anomaly resolution	Verification checking with EM61-MK2 to verify response within anomaly footprint after excavation is less than the anomaly selection threshold.	If no MEC found: 90% confidence < 5% unresolved anomalies. Accept on zero.	There is one lot of 254; 42 anomalies will be resolved.	Lot submittal fails.
Geodetic equipment functionality	All	Position offset of known/temporary control point within 10 cm.	Daily	Redo affected work or reprocess affected data.
Geodetic accuracy	Points used for RTK base stations	Project network tied to HARN, CORS, OPUS or other recognized network. Project control points that are used more than once must be repeatable to within 10 cm.	Repeat occupation of each point used monthly.	Reset points not located at original locations or resurvey point following approved Work plan
Geodetic repeatability	Grid corners/transect points	Measured locations are reoccupied within 10 cm.	1 per lot	Lot submittal fails.

Notes:

1. **The predicted response and error budget will be calculated on the first day on site prior to conducting anomaly reacquisition.**

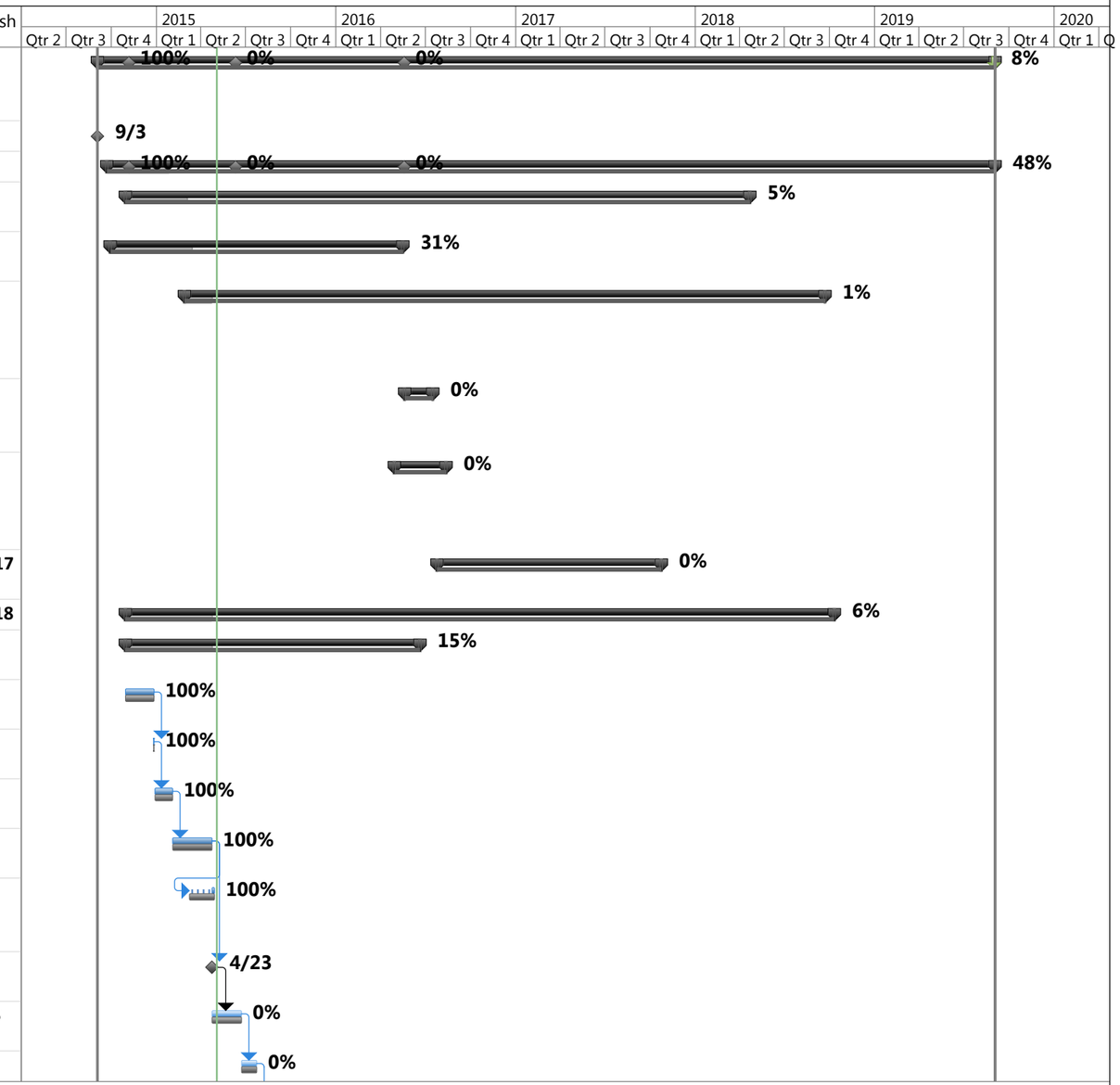
Table 1-3: Performance Metrics for Analog

Requirement	Limited Applicability (Specific to Collection Method/Use)	Performance Standard	Frequency	Consequence of Failure
Repeatability (instrument functionality)	All	All items in test strip detected (trains ear daily to items of interest)	Min 1 daily	Remedial training and additional remedial measures as described in the approved Work plan if due to operator error, or replacement of faulty equipment.

APPENDIX H
PROJECT SCHEDULE

Progress Schedule
Environmental Remediation Activities at Fort Wingate Depot Activity (FWDA) Parcel 3 & Kick-out Area
FWDA, Gallup, NM

ID	WBS	Task Name	% Complete	Duration	Baseline2 Start	Baseline2 Finish
1	**WA**	**Environmental Remediation Activities at Fort Wingate Depot Activity (FWDA) Parcel 3 & Kick-out Area**	**8%**	**1272 days**	**Wed 9/3/14**	**Mon 9/2/19**
2	WA.1	Award	100%	0 days	Wed 9/3/14	Wed 9/3/14
3	**WA.2**	**CLIN 0001 - Task 1 PROJECT MANAGEMENT**	**48%**	**1259 days**	**Mon 9/22/14**	**Mon 9/2/19**
157	**WA.3**	**CLIN 0002 - Task 2 - SWMU 38, Parcel 20 RCRA Facility Investigation (RFI)**	**5%**	**883 days**	**Thu 10/30/14**	**Sat 4/21/18**
220	**WA.4**	**CLIN 0003 - Task 3 Parcel 3 Kick-out Area (KOA) MEC Work Plan**	**31%**	**410 days**	**Mon 9/29/14**	**Sun 5/15/16**
246	**WA.5**	**CLIN 0004 - Task 4 KOA Area MEC Removal Field Work Note: The multiple MILESTONE PAYMENTS are not shown for the acreage increments**	**1%**	**910 days**	**Fri 2/27/15**	**Fri 9/21/18**
290	**WA.14**	**CLIN 0003AC - Subtask 3.1, Soil Investigation in SWMU 14, SWMU 15, SWMU 74, AOC 89, AOC 90 and AOC 91**	**0%**	**40 days**	**Fri 5/20/16**	**Fri 7/15/16**
294	**WA.15**	**CLIN 0005 and CLIN 0006 - OPTION 2 & OPTION 3, AOC 92 Note: The multiple MILESTONE PAYMENTS are not shown for the acreage increments**	**0%**	**74 days**	**Fri 4/29/16**	**Thu 8/11/16**
299	**WA.19**	**CLIN 0003BH, CLIN 0003BI - Subtask 3.2 - Soils Investigation Report**	**0%**	**321 days**	**Mon 7/25/16**	**Mon 10/23/17**
312	**WA.7**	**CLIN 0010 - Task 6, Parcel 11, SWMUs 10 & 40**	**6%**	**1004 days**	**Thu 10/30/14**	**Wed 10/10/18**
313	**WA.7.1**	**Task 6.1 Parcel 11 (SWMU 10 & 40) Investigation and MEC Removal Work Plan**	**15%**	**411 days**	**Thu 10/30/14**	**Sun 6/19/16**
314	WA.7.1.1	Prepare Draft Investigation and Removal Work Plan	100%	38 days	Thu 10/30/14	Fri 12/26/14
315	WA.7.1.2	Submit Draft Investigation & Removal Work Plan to USACE for Review	100%	1 day	Fri 12/26/14	Fri 12/26/14
316	WA.7.1.3	USACE Review of Investigation and Removal Work Plan	100%	35.38 edays	Mon 12/29/14	Mon 2/2/15
317	WA.7.1.4	Respond to USACE comments to Removal Work Plan	100%	58 days	Tue 2/3/15	Thu 4/23/15
318	WA.7.1.5	CLIN0010AA - USACE Accepts Draft Investigation and Removal Work Plan MILESTONE PAYMENT	100%	3 days	Mon 3/9/15	Tue 4/28/15
319	WA.7.1.6	Submit Tribal Draft Investigation and Removal Work Plan	0%	0 days	Thu 4/23/15	Thu 4/23/15
320	WA.7.1.7	Tribal Review of Investigation and Removal Plan	0%	60 edays	Thu 4/23/15	Mon 6/22/15
321	WA.7.1.8	Respond to Tribal comments	0%	20 days	Tue 6/23/15	Thu 7/23/15

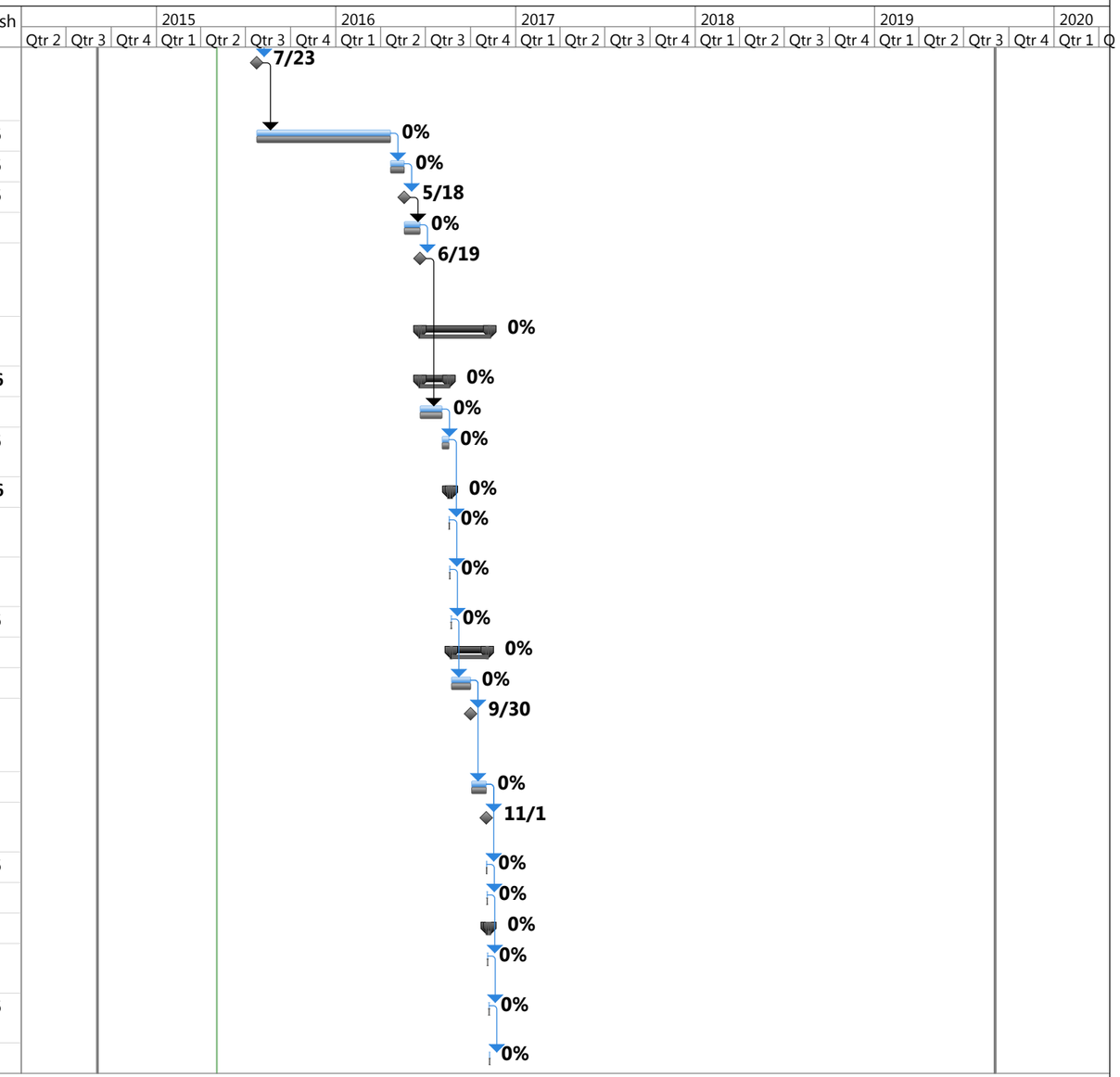


Date: 29 April 2015
FWDA Project Schedule

Critical		Split		Finish-only		Milestone		Project Summary		Inactive Milestone	
Critical Split		Task Progress		Duration-only		Summary Progress		External Tasks		Inactive Summary	
Critical Progress		Manual Task		Baseline Split		Summary		External Milestone		Deadline	
Task		Start-only		Baseline Milestone		Manual Summary		Inactive Task		Slippage	

Progress Schedule
Environmental Remediation Activities at Fort Wingate Depot Activity (FWDA) Parcel 3 & Kick-out Area
FWDA, Gallup, NM

ID	WBS	Task Name	% Complete	Duration	Baseline2 Start	Baseline2 Finish
322	WA.7.1.9	Submit Investigation and Removal Plan for NMED Review and USACE Concurrence	0%	0 days	Thu 7/23/15	Thu 7/23/15
323	WA.7.1.10	NMED Review	0%	272 edays	Thu 7/23/15	Wed 4/20/16
324	WA.7.1.11	Respond to NMED comments	0%	20 days	Thu 4/21/16	Wed 5/18/16
325	WA.7.1.12	Submit Final Work Plan	0%	0 days	Wed 5/18/16	Wed 5/18/16
326	WA.7.1.13	USACE Review	0%	32 edays	Wed 5/18/16	Sun 6/19/16
327	WA.7.1.14	CLIN0010AB - USACE Acceptance of Final Investigation and Removal Plan, Parcel 11 (SWMU 10 & 40) MILESTONE PAYMENT	0%	0 days	Sun 6/19/16	Sun 6/19/16
328	**WA.7.2**	**Task 6.2 Field Work, Parcel 11, SWMU 10 & 40**	**0%**	**101 days**	**Sun 6/19/16**	**Tue 11/8/16**
329	**WA.7.2.7**	**Notifications**	**0%**	**43 days**	**Sun 6/19/16**	**Wed 8/17/16**
330	WA.7.2.7.1	USACE COR Field Mobilization Notice	0%	45 edays	Sun 6/19/16	Wed 8/3/16
331	WA.7.2.7.2	Field Mobilization Notice to BRAC and FWDA	0%	10 days	Thu 8/4/16	Wed 8/17/16
332	**WA.7.2.8**	**Mob and Site Set-up**	**0%**	**3 days**	**Thu 8/18/16**	**Mon 8/22/16**
333	WA.7.2.8.7	Mob, SSHP, Work Plan review, and site orientation	0%	1 day	Thu 8/18/16	Thu 8/18/16
334	WA.7.2.8.8	Establish GPS site control at Parcel 11	0%	1 day	Fri 8/19/16	Fri 8/19/16
335	WA.7.2.8.9	Bush hog clearance area	0%	1 day	Mon 8/22/16	Mon 8/22/16
336	**WA.7.2.9**	**MEC Clearance**	**0%**	**52 days**	**Tue 8/23/16**	**Thu 11/3/16**
337	WA.7.2.9.13	Geophysics	0%	28 days	Tue 8/23/16	Fri 9/30/16
338	WA.7.2.9.14	CLIN 0010AC - Anomaly Geophysical Investigation (948 & Letter) MILESTONE PAYMENT	0%	0 days	Fri 9/30/16	Fri 9/30/16
339	WA.7.2.9.15	Conduct clearance	0%	22 days	Mon 10/3/16	Tue 11/1/16
340	WA.7.2.9.16	CLIN 0010AD MEC Removal (948 & Letter) MILESTONE PAYMENT	0%	0 days	Tue 11/1/16	Tue 11/1/16
341	WA.7.2.9.17	MEC Waste Mgt	0%	1 day	Wed 11/2/16	Wed 11/2/16
342	WA.7.2.9.18	Site Reclamation	0%	1 day	Thu 11/3/16	Thu 11/3/16
343	**WA.7.2.10**	**Demob**	**0%**	**3 days**	**Fri 11/4/16**	**Tue 11/8/16**
344	WA.7.2.10.7	NM Licensed surveyor collects sample location data	0%	1 day	Fri 11/4/16	Fri 11/4/16
345	WA.7.2.10.8	Mob equipment and personnel to next site	0%	1 day	Mon 11/7/16	Mon 11/7/16
346	WA.7.2.10.9	Site closeout walk with USACE	0%	1 day	Tue 11/8/16	Tue 11/8/16

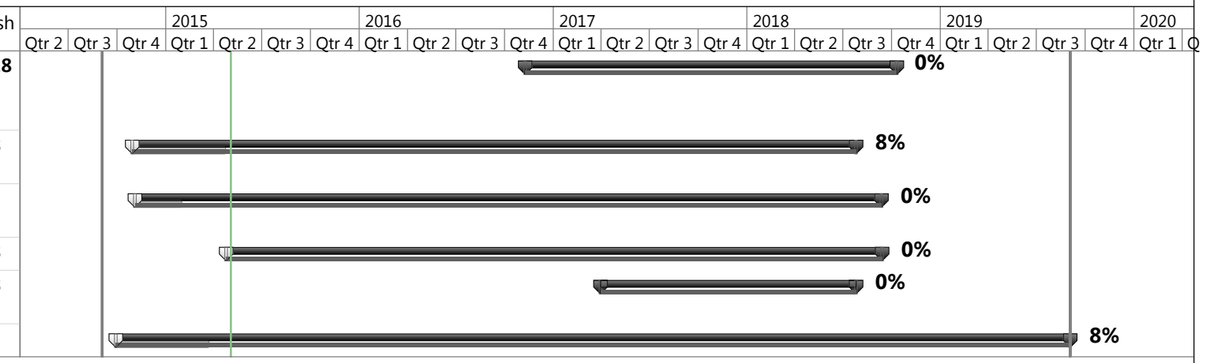


Date: 29 April 2015
FWDA Project Schedule

Critical		Split		Finish-only		Milestone		Project Summary		Inactive Milestone	
Critical Split		Task Progress		Duration-only		Summary Progress		External Tasks		Inactive Summary	
Critical Progress		Manual Task		Baseline Split		Summary		External Milestone		Deadline	
Task		Start-only		Baseline Milestone		Manual Summary		Inactive Task		Slippage	

Progress Schedule
Environmental Remediation Activities at Fort Wingate Depot Activity (FWDA) Parcel 3 & Kick-out Area
FWDA, Gallup, NM

ID	WBS	Task Name	% Complete	Duration	Baseline2 Start	Baseline2 Finish
347	**WA.7.3**	**Task 6.3 Parcel 11 (SWMU 10 & 40) Investigation & Removal Report MILESTONE PAYMENT**	**0%**	**492 days**	**Wed 11/9/16**	**Wed 10/10/18**
363	**WA.8**	**CLIN 0011 - Task 7, Parcel 22, SWMUs 10, 27, and 70 and AOC 88A & 88B**	**8%**	**950 days**	**Thu 10/30/14**	**Wed 7/25/18**
406	**WA.9**	**CLIN 0012 - Task 8, Operations Corrective Action Measures Unit (CAMU)**	**0%**	**980 days**	**Tue 11/4/14**	**Tue 9/11/18**
413	**WA.10**	**CLIN 0014 - Task 10, Maintenance**	**0%**	**862 days**	**Fri 4/24/15**	**Wed 9/12/18**
446	**WA.12**	**CLIN 0007 - OPTION 4 - Soil Removal, backfill and Report**	**0%**	**338 days**	**Fri 3/31/17**	**Wed 7/25/18**
451	**WA.13**	**CLIN 0009 - OPTION 5 - SharePoint Site**	**8%**	**1254 days**	**Mon 9/29/14**	**Mon 9/2/19**



Date: 29 April 2015
FWDA Project Schedule

Critical		Split		Finish-only		Milestone		Project Summary		Inactive Milestone	
Critical Split		Task Progress		Duration-only		Summary Progress		External Tasks		Inactive Summary	
Critical Progress		Manual Task		Baseline Split		Summary		External Milestone		Deadline	
Task		Start-only		Baseline Milestone		Manual Summary		Inactive Task		Slippage	

APPENDIX I

ENVIRONMENTAL PROTECTION PLAN

Includes the Hazardous Waste Contingency Plan and the Waste Management Plan

(Appendix I is included in electronic-only format on the enclosed compact disc)

APPENDIX J

CULTURAL RESOURCES MANAGEMENT PLAN

(Appendix J is included in electronic-only format on the enclosed compact disc)

APPENDIX K

STATISTICAL SELECTION OF DGM ANOMALIES

Statistical Selection of DGM Anomalies for Intrusive Investigation

Based on the results of the DGM survey, a statistically representative subset of anomalies has been selected for intrusive investigation. The Estimating a Proportion method, described below, was used to calculate the number of randomly selected DGM anomalies that need to be classified. The calculation is used to determine with 95% confidence and ± 5% sampling error the proportion of munitions-related to non-munitions-related DGM anomalies within the population of anomalies detected along the investigated transects.

Estimating a Proportion Method

When a population size is large or unknown, the necessary sample size of DGM anomalies to be intrusively investigated can be estimated using the following statistical sample size formula:

$n_0 = Z_\alpha{}^2 pq / e^2$

Z_α = desired confidence level

p = proportion of DGM anomalies classified as munitions-related

q = proportion of DGM anomalies classified as non-munitions-related (q = 1-p)

e = acceptable margin of error for proportion being estimated

n0 = statistical sample size for a large population

When the population size is known, the following finite population correction can be used to reduce the number of anomalies required to obtain the same confidence level:

$n_1 = n_0 / 1 + (n_0/N)$

n_1 = adjusted statistical sample size for a finite population

n_0 = statistical sample size for a large population

N = size of the population (number of DGM anomalies)

Example:

When estimating the variance of proportional variables (i.e., munitions-related or non-munitions-related), it is most conservative to estimate a population proportion of 50% (p=0.5); the result is that variance (pq) is maximized, and thus, the required sample size is also maximized. Using a z-statistic for a 95% confidence level (Z_α=1.96) and a margin of error of 5% (e=0.05), the solution for n_0 becomes:

$n_0 = Z_\alpha{}^2 pq / e^2 = 1.96^2(.5)(.5) / .05^2 = 384$

This formula estimates that a maximum of 384 randomly selected DGM anomalies must be classified to determine with 95% confidence and ± 5% sampling error the proportion of munitions-related to non-munitions-related DGM anomalies in a large or unknown population. Based on the number of non-QC Seed DGM anomalies identified along the investigated transects (3,363), the finite population correction is solved as follows:

$n_1 = n_0 / (1 + (n_0/N)) = 384/(1 + (384/3363)) = 344.7$

Therefore, intrusively investigating 345 anomalies will allow us to determine with 95% confidence and ± 5% sampling error the distribution of munitions-related to non-munitions-related items present among the anomalies identified along the investigated transects.

APPENDIX L

SPILL PREVENTION CONTROL AND COUNTERMEASURE PLAN

APPENDIX M

RESPONSE TO COMMENTS