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DEPARTMENT OF THE AIR FORCE

HEADQUARTERS 49TH WING (ACC)
HOLLOMAN AIR FORCE BASE, NEW MEXICO

26 November 2014

DeAnna Rothhaupt
Chief, Holloman AFB Environmental
550 Tabosa Avenue
Holloman AFB NM 88330-8458

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DEC - 3 2014

USEPA, Region 6 (6PD-F)
Attn: Mr. Chuck Hendrickson, Project Manager
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Dear Mr. Hendrickson,

Holloman AFB is pleased to submit the Final Engineering Evaluation/Cost Analysis for FI857a Former Bunker Munitions Response Site, Holloman Air Force Base, NM.

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

If you have any questions, please contact me (575) 572-3931 or by email at deanna.rothhaupt@holloman.af.mil.

Sincerely,

DEANNA ROTHHAUPT, GS-12, DAFC

Attachment:
Final Engineering Evaluation/Cost Analysis for FI857a Former Bunker Munitions Response Site, Holloman Air Force Base, NM.

cc:

(w/Atch)	(w/Atch)	(w/o Atch)
Mr. David Strasser	Mr. John Kieling, Chief	Mr. Will Moats
Hazardous Waste Bureau	Hazardous Waste Bureau	Hazardous Waste Bureau
5500 San Antonio Dr, NE	2905 Rodeo Park Dr, East, Building 1	5500 San Antonio Dr, NE
Albuquerque NM 87109-4127	Santa Fe NM 87505-6303	Albuquerque NM 87109-4127

FINAL

ENGINEERING EVALUATION/COST ANALYSIS

FI857a FORMER BUNKER MRS

HOLLOMAN AIR FORCE BASE
NEW MEXICO
RCRA PERMIT NUMBER: NM6572124422-2

Performance Based Remediation
Contract Number: FA8903-13-C-0008

Prepared for:

AIR FORCE CIVIL ENGINEER CENTER
2261 Hughes Ave., Suite 163
Joint Base San Antonio Lackland, Texas 78236-9853

December 2014

Prepared by:

FPM Remediations, Inc.

584 Phoenix Drive
Rome, NY 13441

URS Group, Inc.
7720 N 16th Street, Suite 100
Phoenix, AZ 85020-4493

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EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) was prepared by FPM Remediations, Inc. (FPM) under FPM's Air Force Civil Engineer Center Contract FA8903-13-C-0008, to support the United States Air Force (USAF) Military Munitions Response Program. The purpose of the EE/CA is to develop and evaluate Removal Action (RA) alternatives for reduction of Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) risks to human health potentially present at the FI857a Former Bunker Munitions Response Site (MRS) located at Holloman Air Force Base (AFB), near Alamogordo, New Mexico. The MEC/MPPEH may be present on the surface and subsurface of the ground due to past military munitions use of the property.

Holloman AFB is located in south-central New Mexico, seven miles west of the city of Alamogordo in Otero County. The 0.8-acre FI857a MRS is located in the southeast portion of the Base. It is suspected that the site was used as a former storage bunker. Based on the Comprehensive Site Evaluation Phase II, munitions that may be found at this site include M38 practice bombs and hand grenades.

The following four RA alternatives were evaluated for FI857a as part of this EE/CA:

1. No Action,
2. Land Use Controls (LUCs),
3. Surface Removal of MEC/MPPEH Combined with LUCs, and
4. Surface and Subsurface Removal of MEC/MPPEH.

No Action alternative involves no active response or land use restrictions to locate, remove, dispose of, or limit the exposure to any potential MEC/MPPEH present within the MRS. The No Action approach is routinely retained in the EE/CA evaluation of alternatives in accordance with the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to provide a baseline for comparison of other response technologies and alternatives.

The LUCs alternative includes engineering controls (e.g., fencing and warning signage) and institutional controls (e.g., military orders preventing access to the MRS). As part of this alternative, fencing would be placed along the perimeter of the site and frequent signage would be put in place.

For Alternative 3, the Surface Removal of MEC/MPPEH includes instrument-aided surface clearance of any MEC/MPPEH items which may exist on the surface of the ground or are protruding from the ground, and are located during the sweep and subsequently removed by the Unexploded Ordnance (UXO) team. LUCs would be implemented upon completion of surface MEC/MPPEH removal to minimize potential exposure to remaining subsurface MEC/MPPEH. LUCs will be comprised of educational and awareness programs for Base personnel and visitors and can be undertaken in number of formal and informal methods including both printed and visual media. LUCs will also include dig permits from Holloman AFB prohibiting digging without a construction support by UXO personnel.

Alternative 4 includes 100% surface removal of MEC/MPPEH and removal of the following subsurface anomalies:

- Those that show characteristics of burial pits and

- All individual geophysical anomalies above the established threshold based on the MRS background noise determined by an Instrument Verification Strip/Geophysical System Verification.

In no case will any excavations and removals exceed 10 feet. Removal activities will be performed by experienced UXO-qualified personnel. Following removal of all anomalies identified, the intrusive investigated area will be restored as close as possible to its original state.

These four (4) alternatives were evaluated using the effectiveness, implementability, and cost criteria set forth in the NCP guidance for conducting EE/CAs. Alternative 4 was ranked best in terms of effectiveness and cost and had the best overall ranking. Alternative 4 is the recommended RA alternative for FI857a MRS. It is both the most protective of human health over the long term and the most cost effective.

According to Sections 300.415(m) and 300.820 of the NCP, community relations and administrative record activities will be performed as two forms of public participation necessary for all RAs. The Lead Agency (USAF) will designate a spokesperson to inform the public about the release and actions taken, to respond to questions, and to notify immediately affected citizens, and State and local officials. In addition, the USAF will establish an administrative record and make the administrative record available to the public at a central location or near the site, if applicable. Comments from the public on the selection of this RA alternative will be incorporated into the Action Memorandum identifying the preferred alternative for the site.

TABLE OF CONTENTS

SECTION PAGE

1.0 INTRODUCTION 1-1
1.1 Project Authorization 1-1
1.2 Purpose and Scope 1-1
1.3 Report Organization 1-2
2.0 MRS CHARACTERIZATION 2-1
2.1 Installation Location and Background 2-1
2.2 Former Bunker Location and Operational History 2-2
2.3 Physical Description 2-2
2.3.1 Climate 2-2
2.3.2 Topography 2-2
2.3.3 Soils 2-7
2.3.4 Geology and Hydrogeology 2-7
2.3.5 Hydrology 2-7
2.3.6 Vegetation 2-8
2.3.7 Ecological Profile 2-8
2.3.8 Structures and Utilities 2-8
2.3.9 Current and Future Land Uses 2-8
2.4 Previous Investigations 2-8
2.4.1 Modified CSE Phase I 2-9
2.4.2 CSE Phase II 2-9
2.5 Streamlined Risk Evaluation 2-10
2.5.1 MEC Exposure Pathway Analysis 2-10
2.5.2 MC Exposure Pathway Analysis 2-10
3.0 DEVELOPMENT OF REMOVAL ACTION OBJECTIVES 3-1
3.1 Justification For the Proposed Removal Action 3-1
3.2 Applicable or Relevant and Appropriate Requirements 3-1
3.2.1 Chemical Specific ARARs 3-2
3.2.2 Location-Specific ARARs 3-2
3.2.3 Action-Specific ARARs 3-2
3.3 Removal Action Objective 3-2
4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES 4-1
4.1 General Response Actions 4-1
4.1.1 Identifications of Technologies and Process Options 4-1
4.2 Alternative Description 4-2
4.2.1 Alternative 1 - No Action 4-2
4.2.2 Alternative 2 - Land Use Controls 4-3
4.2.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs 4-4

4.2.4 Alternative 4 - Surface and Subsurface Removal of MEC/MPPEH 4-5
4.3 Evaluation Criteria 4-5
4.4 Individual Analysis of Alternatives 4-6
4.4.1 Alternative 1 – No Action 4-6
4.4.2 Alternative 2 – Land Use Controls 4-7
4.4.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs 4-8
4.4.4 Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH 4-9
5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES 5-1
5.1 Effectiveness 5-1
5.2 Implementability 5-1
5.3 Cost 5-2
5.4 Overall Ranking of Alternatives 5-2
6.0 RECOMMENDATIONS 6-1
6.1 Public Participation 6-1
6.2 Removal Action Schedule 6-2
7.0 REFERENCES 7-1

LIST OF FIGURES

FIGURE **PAGE**

Figure 2-1 Holloman Air Force Base Location 2-3
Figure 2-2 FI857a Former Bunker MRS Location 2-5
Figure 2-3 CSE Phase II Visual Survey Results FI857a MRS 2-11
Figure 2-4 XRF Lead Sample Results FI857a MRS 2-13
Figure 2-5 FI857a MRS MEC Exposure Pathway Analysis 2-16
Figure 2-6 FI857a MRS MC Exposure Pathway Analysis 2-17

LIST OF TABLES

TABLE **PAGE**

Table 3-1 List of Potential Action-Specific ARARs 3-3
Table 4-1 Potentially Applicable MEC Technologies and Process Options at FI857a MRS .. 4-3
Table 5-1 Effectiveness Criteria Evaluation 5-2
Table 5-2 Implementability Criteria Evaluation 5-3
Table 5-3 Cost Criteria Evaluation 5-3
Table 5-4 Alternatives Evaluation 5-4
Table 6-1 Removal Action Schedule 6-2

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LIST OF ABBREVIATIONS AND ACRONYMS

%	Percent
°F	Degrees Fahrenheit
AAAF	Alamogordo Army Air Field
AFB	Air Force Base
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
BIP	Blow-in-Place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	Contaminant of Potential Concern
CSE	Comprehensive Site Evaluation
DDESB	Department of Defense Explosives Safety Board
DGM	Digital Geophysical Mapping
DoD (DD)	Department of Defense
EE/CA	Engineering Evaluation/Cost Analysis
EM	Engineering Manual
EM61	Geonics EM61-MK2
EOD	Explosive Ordnance Disposal
ESS	Explosives Safety Submission
FPM	FPM Remediations, Inc.
FS	Feasibility Study
ft	feet
G-858	Geometrics G-858 Cesium Vapor Magnetometer
GRA	General Response Action
GSV	Geophysical System Verification
HDR	HDR Environmental, Operations and Construction, Inc.
HASP	Health and Safety Plan
HSTT	High Speed Test Track
in	inches
IVS	Instrument Verification Strip
lb	pound
kg	kilogram
LOD	Limit of Detection
LUCs	Land Use Controls
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MEC	Munitions and Explosives of Concern
mg	milligram
MHAT	MEC Hazard Assessment Tool
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard

LIST OF ABBREVIATIONS AND ACRONYMS (continued)

MRA	Munitions Response Area
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NA	Not Applicable
NFA	No Further Action
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMED	New Mexico Environment Department
NTCRA	Non-Time-Critical Removal Action
ppm	parts per million
PRSC	Post Removal Site Control
RA	Removal Action
RACER	Remedial Action Cost Engineering and Requirements
RAO	Removal Action Objective
RI	Remedial Investigation
RSL	Regional Screening Level
SARA	Superfund Amendments and Reauthorization Act
SDA	Safe Disposal Area
SSL	Soil Screening Level
TBC	To Be Considered
TDS	Total Dissolved Solids
SKY	Sky Research, Inc
TMV	Toxicity, Mobility or Volume
USAF	United States Air Force
USACE	U. S. Army Corp of Engineers
U.S.C.	United States Code
USEPA	United States Environmental Protection Agency
UXO	Unexploded Ordnance
WP	Work Plan
WSMR	White Sands Missile Range
WWII	World War II
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) is being performed in support of the United States Air Force (USAF) Military Munitions Response Program (MMRP) at Holloman Air Force Base (AFB) near Alamogordo, New Mexico. The purpose of this EE/CA is to develop and evaluate Removal Action (RA) alternatives and associated costs to mitigate hazards associated with surface and subsurface Munitions and Explosives of Concern (MEC)/Material Potentially Presenting an Explosive Hazard (MPPEH) suspected to be present within the FI857a Former Bunker Munitions Response Site (MRS). This hazard was identified during the Comprehensive Site Evaluation (CSE) Phase II (HDR Environmental, Operations and Construction, Inc. [HDR], 2013) investigation at Former Bunker Munitions Response Area (MRA) 857. The EE/CA assumes that no additional site assessment activities will be necessary to determine the appropriate RA alternative.

This document follows the United States Environmental Protection Agency's (USEPA's) guidance provided in document 540/R93/057 Guidance on Conducting Non-Time-Critical Removal Actions (NTCRAs) under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (USEPA, 1993).

1.1 Project Authorization

The MMRP was created by Congress in 2001 under the Defense Environmental Restoration Program as established by Section 211 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 and is codified in Sections 2701-2710 of Title 10 of the United States Code (U.S.C.). This EE/CA is being developed in accordance with the USAF MMRP cleanup process that follows the requirements of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) as promulgated under the CERCLA and as amended by SARA. The EE/CA is being completed by the FPM Remediations, Inc. (FPM) Team, under FPM's Air Force Civil Engineer Center Contract FA8903-13-C-0008, to support the USAF MMRP.

The USAF is the Lead Agency for this EE/CA. Participation of and cooperation with federal, state, and local authorities and the local public will be solicited for the duration of this activity and for all environmental restoration activities at Holloman AFB. Participation of these entities is required for the environmental restoration process and aids in ensuring the protection of human health and the environment. Federal, state, and local authorities will have input into the actions implemented at Holloman AFB through planning meetings, plan review, and the public comment process. Concerns of the federal, state, and local authorities will be solicited and provisions of federal, state, and local regulations will be given full consideration for all actions taken at Holloman AFB.

1.2 Purpose and Scope

The purpose of this EE/CA is to evaluate alternatives to reduce risks associated with suspected surface and subsurface explosive hazards at the FI857a Former Bunker MRS to support an RA. The CSE Phase II investigation found physical evidence of Munitions Debris (MD) at FI857a MRS indicating the potential presence of surface and subsurface MEC/MPPEH. The EE/CA documents existing site characterization data, provides an analysis of alternatives, and identifies the preferred action to protect human health and the environment.

1.3 Report Organization

The EE/CA has been organized as follows:

Section 1: Introduction – describes the project authorization and purpose and scope.

Section 2: MRS Characterization – presents Holloman AFB location and operational history, FI857a MRS description, previous investigations performed at FI857a, and streamlined risk evaluation.

Section 3: Development of Remedial Action Objectives (RAOs) – describes the regulatory requirements for the RA, including Applicable or Relevant and Appropriate Requirements (ARARs) and the RAOs.

Section 4: Identification and Analysis of RA Alternatives – provides detailed description and analysis of RA alternatives.

Section 5: Comparative Analysis of RA Alternatives – provides a comparative analysis of alternatives.

Section 6: Recommendations – summarizes the recommended RA alternative and provides the RA schedule.

Section 7: References – provides a list of references used to develop this EE/CA.

2.0 MRS CHARACTERIZATION

2.1 Installation Location and Background

Holloman AFB is located in south-central New Mexico, seven miles west of the city of Alamogordo in Otero County (**Figure 2-1**). It is adjacent to the White Sands Missile Range (WSMR). A portion of the Base to the south is bordered by Route 70, which also runs roughly north-south and parallel to the eastern boundary of the Base. Holloman AFB occupies approximately 50,763 acres of land. It is contiguous to the much larger (2.2 million acre) WSMR, and located to the southeast to the WSMR. The southern portion of Holloman AFB contains the flight line, composed of a series of runways running north-south, east-west, and northeast southwest. The Main Base is located at the southeast corner of the installation, where Route 70 borders the installation. The Main Base contains housing and administrative buildings. The West Area and the North Area refer to the improved areas around the original airfield (southeastern triangle formed by the runways). The High Speed Test Track (HSTT) runs north-south and is located northwest of the airfield. The track is the world's longest of its kind at 9.5 miles and has been used for an array of missile testing for decades and is still in use today. Access to Holloman AFB requires admittance through the security gate and there is a fence around the installation.

Holloman AFB began nine months after the U.S. entered World War II (WWII), and was an integral facility in the early stages of the U.S. space program throughout the Cold War. On 6 February 1942, construction began on an extensive bombing and gunnery range later known as the Alamogordo Bombing and Gunnery Range. On 10 August 1942, the Alamogordo Army Air Field (AAAF) was officially established. Because the facility was initially intended to be used by Great Britain as part of their WWII British Training Program for bomber crews, the Base was designed after Royal Air Force bases. The first atomic bomb was detonated at the Trinity Site in the northwest corner of the Alamogordo Bombing and Gunnery Range (now the WSMR) on 16 July 1945. In 1946, as more lands became available within the Tularosa Basin, the AAAF was reassigned to be a missile development facility. With the creation of the USAF as a separate service, the facility came under the direction of the Air Materiel Command, which decided that the facility would be used to conduct guided missile programs. On 13 January 1948, the Base was renamed Holloman AFB, after Col. George V. Holloman, an early pioneer in guided missile development.

To support the Holloman mission of developing guided missiles, the Army Ordnance Corps built White Sands Proving Grounds at about this time. The combination of the White Sands Proving Grounds and Alamogordo Bombing Range was 100 miles long and 40 miles wide. On 1 September 1952, the two ranges were combined to form the Integrated White Sands Range. From 1952 to 1970, missile development and testing at White Sands included the Snark, Matador, Mace, Falcon, Aerobee, JB-2 Loon, and Firebee missiles. High speed sled tests, high altitude balloon projects, and Aeromedical Field Laboratory experiments were also conducted. Testing activities included the Central Inertial Guidance Test Facility and the Radar Target Scatter Test Facility.

In 1972, the Base was taken over by Tactical Air Command and became primarily a fighter base with some continued developmental testing. On 15 November 1991, command responsibility passed from the 833rd Air Division to the 49th Wing. Today, the 49th Wing provides leadership

to the installation. Two projects begun during the Cold War era continue on the Base: the HSTT and the Primate Research Lab (both considered tenant organizations).

2.2 Former Bunker Location and Operational History

The Former Bunker MRA 857 consists of 20.6 acres and is located approximately 3,280 ft east of Runway 22-16 and 1,300 ft north-northwest of a water tower (**Figure 2-1**). According to available historical information, the area is a historic storage bunker and suspected former security forces training area. The 1996 archaeological survey performed at this MRA (Sale et al., 1996a) identified bomb tail section, four missile casings, nine bomb casings, drone parts, and a 1942 .30-06 caliber cartridge within the remnants of a collapsed wooden tower. Laboratory of Anthropology Site Record describes the area as an "ammo storage (approx. 70 x 70 x 10') hole" with ammunition boxes and approximately 350 .30-06 caliber cartridges along with wood posts, wire mesh, and a sawhorse.

Based on the results of the CSE Phase II investigation, the Former Bunker MRA 857 was recommended to be split into two MRSs due to MD: FI857 encompassing 19.8 acres and FI857a encompassing 0.8 acres (**Figure 2-2**). FI857 MRS was recommended for No Further Action (NFA). The FI857a Former Bunker MRS contains small arms, hand grenade, and M38 practice bomb debris and is the focus of this EE/CA.

2.3 Physical Description

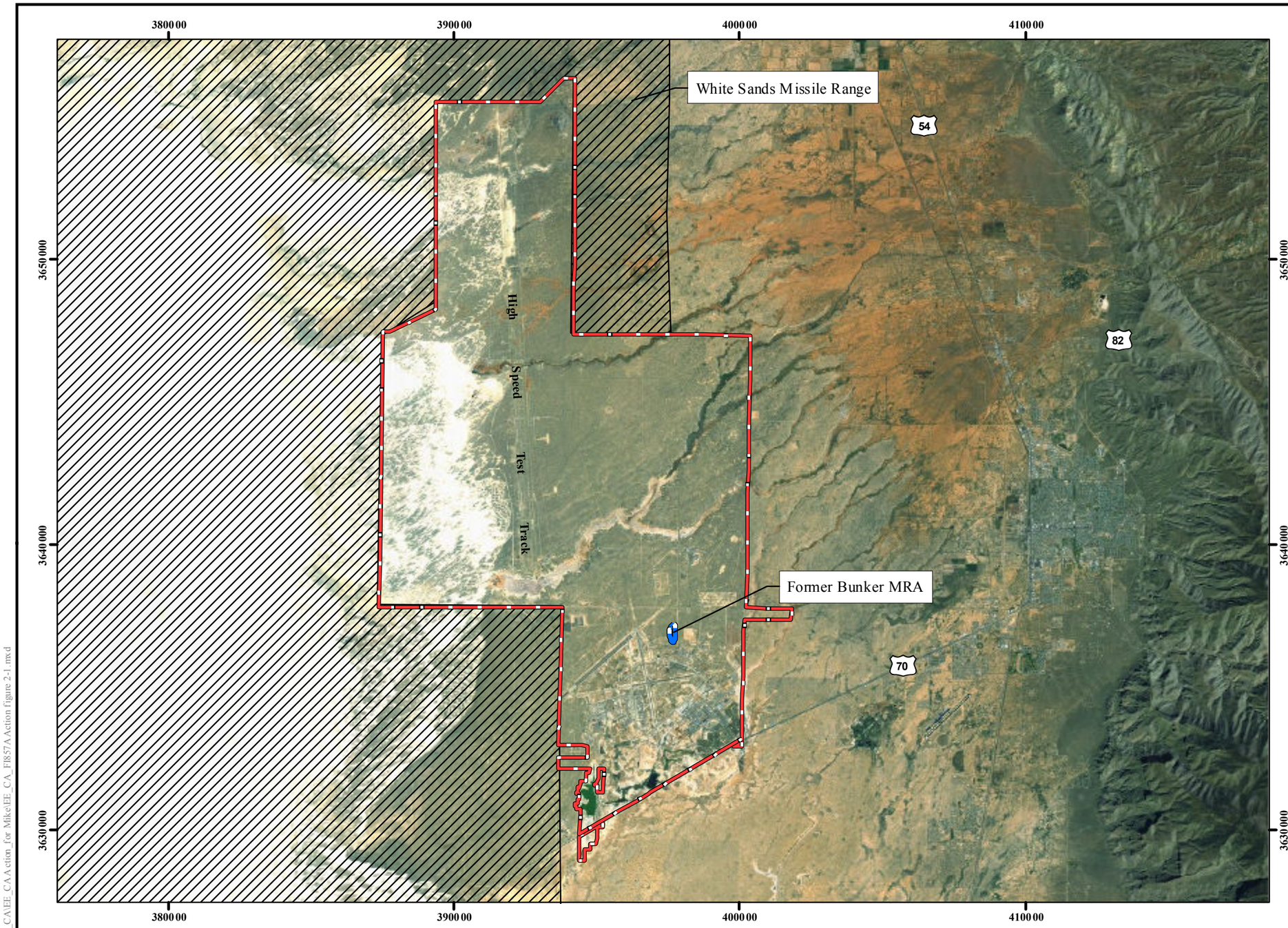
2.3.1 Climate

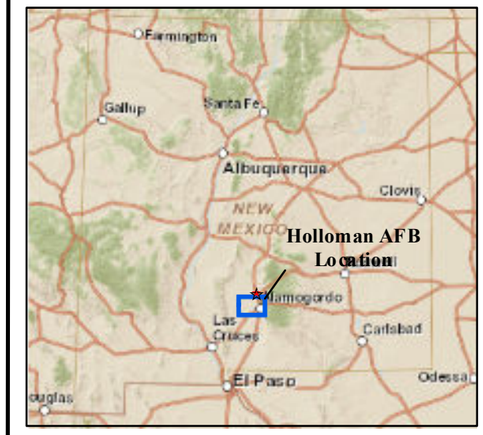
Holloman AFB is located in a semi-arid region within the northern portion of the Chihuahuan Desert. Its climate resembles other semi-arid regions with warm to hot summer days, cool nights, and mild winters. Monthly mean high temperatures range from 55 degrees Fahrenheit (°F) in January to 93.6°F in August. Monthly mean low temperatures range from 29°F in January to 66°F in July. Evapotranspiration is usually high due to dry air, large daily solar radiation totals, seasonally high winds, and warm temperatures. Seasonal fluctuation in precipitation rates is a result of prevailing wind directions, which can bring in frontal storms from the north or the Pacific or Caribbean cyclonic systems. Holloman averages 13.20 inches (in) of annual rainfall. Nearly half of this amount falls within the months of July through September, known as the summer monsoons. Monsoon thunderstorms are generally short in duration and high in intensity. Occurrences are highly variable from year to year and one or two short-term events may contain a large percentage of the net annual precipitation. Average annual snowfall is approximately 4.5 in.

2.3.2 Topography

Holloman AFB lies within the Tularosa basin of south-central New Mexico. This area is part of the Mexican Highland section of the Basin and Range physiographic province and is characterized by fault block mountains interspersed with low desert plains and basins. The Base lies on relatively flat alluvial plains below the Sacramento Mountains. These plains are bordered to the west by the White Sands dune field. Elevations range from 4,000 to 4,250 feet (ft) above mean sea level (Sky Research, Inc. [SKY], 2011)

The FI857a MRS exhibits relatively flat topography.





Legend

Installation Boundary

NOTES:

Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator — Horizontal Datum: North American 1983
False Easting: 500,000.0000 — False Northing: 0.0000
Central Meridian: -105.0000 — Scale Factor: 0.9996
Latitude Of Origin: 0.0000 — Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 12,000 feet

0 1,850 3,700 Meters

0 6,000 12,000 Feet

N W E S

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-1

Holloman Air Force Base Location

FPM Remediations, Inc.

2014

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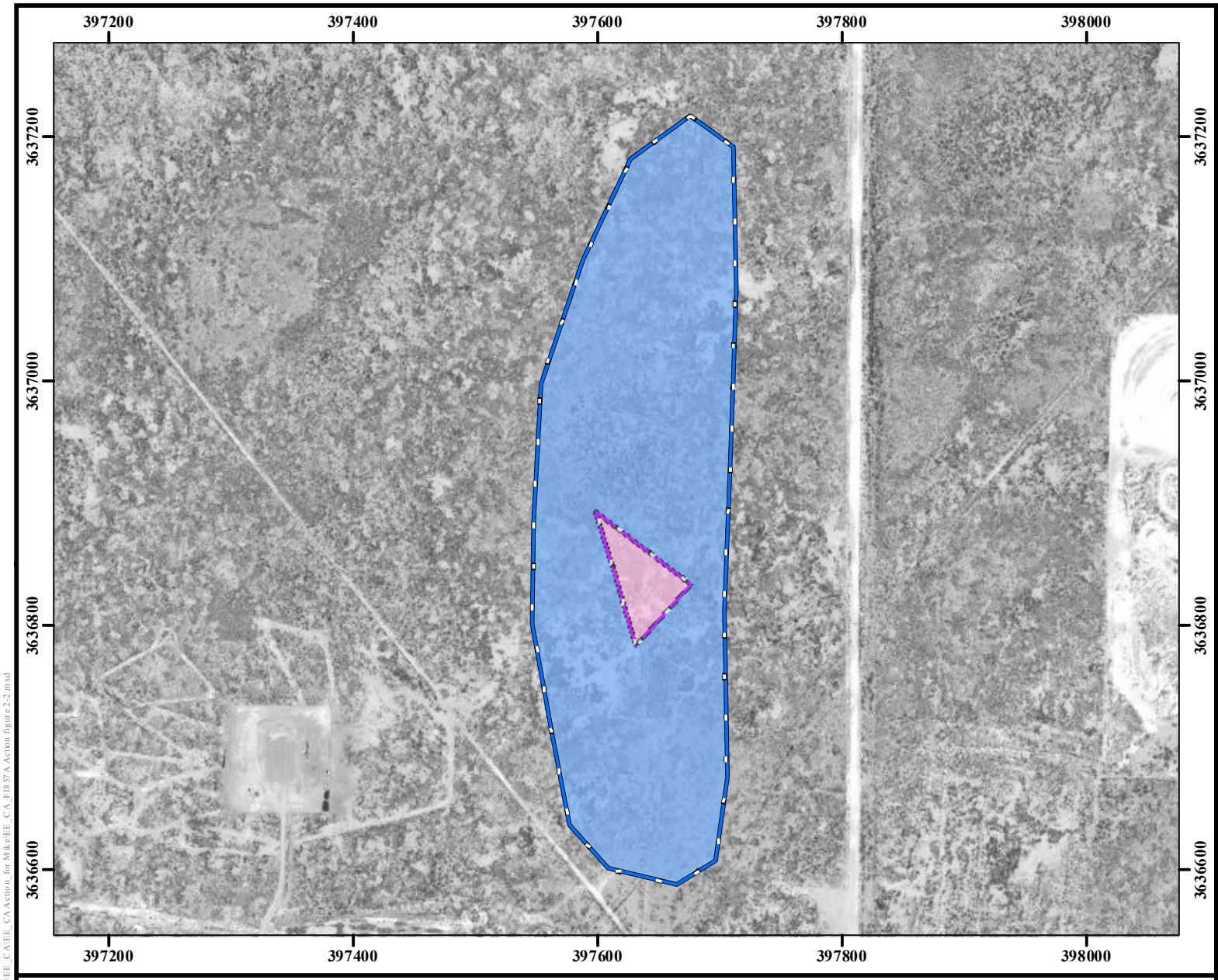

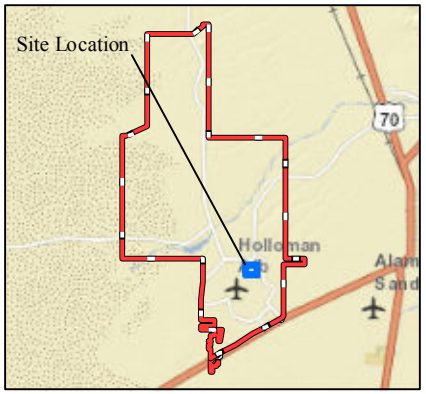

Legend

- Former Bunker MRA 857 (20.6 acres)
- FI857a Former Bunker MRS (0.8 acres)-EE/CA
- FI857 Former Bunker MRS No Further Action (19.8 acres)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-2

FI857a Former Bunker
MRS Location

NOTES:
Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 400 feet
0 60 120 Meters
0 200 400 Feet

N W E S

FPM Remediations, Inc.

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2.3.3 Soils

The soils on Holloman AFB are basin fill deposits formed primarily from alluvial and eolian processes. All soils have a high gypsum and salt content, primarily due to the eastern migration of gypsum sands from WSMR and White Sands National Monument. Holloman AFB has three primary soil types: several associations and complexes of Holloman, Gypsum Land, and Yesum soils, located in the flats; Dune Land, found in the White Sands dunes; and Mead silty clay loam soil, found in the alluvial floodplains (including most jurisdictional wetlands). None of the soil types are very productive, due to high gypsum and salt content, and all are highly subject to both wind and water erosion when the vegetation is sparse or the soil is exposed.

The soils at the FI857a MRS consist of the Yesum-Nasa complex.

2.3.4 Geology and Hydrogeology

Holloman AFB is located in the Tularosa Basin, a downfaulted, closed, intermountain basin located in the southern portion of the Rio Grande Rift. The Tularosa Basin is a bolson, which is a basin with no surface drainage outlet, in which sediments are carried by surface water into the closed basin and deposited (Bhate Environmental Associates, Inc., 2007). Basin fill of the Tularosa Basin is derived from the erosion of the uplifted material and fluvial deposits from the Rio Grande River. The Basin fill consists of unconsolidated coarse- to fine-grained alluvial fan deposits along the rims of the basin that are gradational toward the basin into finer-grained alluvial, fluvial, and lacustrine deposits. Evaporite materials, such as selenite, are present.

Prominent local physiographic features include the Sacramento Mountains to the east, San Andres Mountains, and White Sands National Monument to the west (49th Fighter Wing, 2009). The Tularosa Basin was formed as a structural trough during the Middle to Late Cenozoic era. Alluvial fill deposition includes; sand, gravel, and clay in alluvial fans along the basin margins and extensive lake, alluvial, and evaporate deposits within the interior basin. Streams sustained by groundwater discharge within the basin include Salt Creek and Malpais Spring. It is estimated that the groundwater resources of the Tularosa Basin contain over 100 million-acre ft of brackish groundwater. A wide range of water chemistries including sodium chloride, carbonate, and sulfate-based brine waters exist in the basin and water with salinity from 1,000 parts per million (ppm) Total Dissolved Solids (TDS), approximate to fresh water, to over 20,000 ppm TDS, approximate to sea water, can be found within the basin. The primary source of groundwater recharge is percolation of rainwater and a minor contribution from stream run-off along the western edge of the Sacramento Mountains.

Beneath Holloman AFB, groundwater ranges from 5 to 50 ft below ground surface (bgs), with shallower groundwater found on the southern end of the Base. Groundwater flow is generally toward the southwest with localized influences from the variations in Base topography with shallower groundwater found on the southern end of the Base (SKY, 2011).

2.3.5 Hydrology

The only permanent water in the Tularosa Basin is found in small streams between Alamogordo and Three Rivers, New Mexico. There are no perennial streams within Holloman AFB or in the nearby surrounding landscape; however, a set of perennial pools exist within the Base. They are the final one-third of the Lost River, a set of pools near the confluence of Ritas and Malone Draws, and the Salt Lakes just south of the Lost River and Camera Pad Road Pond. There are at least nine prominent east-west drainages that receive intermittent flows during seasonal

thunderstorms. The largest of these drainages is the Lost River drainage system, including Malone Draw, Carter Draw, and Ritas Draw. Prior to extensive management of the surface topography and construction of U.S. Highway 70/82, Dillard Draw emptied into the Main Base, creating a network of flats and playas including what are now Lake Holloman, Stinky Playa, and Pond G. Construction activities have disrupted the natural flow of this wetland ecosystem (SKY, 2011).

There are no wetlands or surface water associated with the FI857a MRS.

2.3.6 Vegetation

The vegetation of Holloman AFB is consistent with that of the Tularosa Basin and includes mesquite, creosote bush, and grasses. Succulents such as cactus, agave, and yucca also occur (SKY, 2011).

Vegetation at the FI857a MRS is consistent with desert scrubland.

2.3.7 Ecological Profile

No federally listed species covered under the Endangered Species Act currently reside at Holloman AFB. Several federally listed species, however, have been observed at the Base in the past. Mountain plover (proposed federally threatened) nested at Lake Holloman during the 1980s. Brown pelicans (recently delisted) are occasionally observed at Lake Holloman and the constructed wetlands. Peregrine falcons (recently delisted) regularly forage at Lake Holloman. Five other sensitive species currently receive no federal protection: a lichen (*A. clauzadeana*), proposed for rare and endangered listing; the grama grass cactus, included due to its former candidate status; the White Sands pupfish, a state-endangered species; the western burrowing owl, a species of concern; and the western snowy plover, also a species of concern.

No rare, threatened or endangered species are expected to inhabit FI857a MRS.

2.3.8 Structures and Utilities

There are 716 buildings within a two-mile radius of the FI857a MRS, primarily to the south. These buildings include Base residential housing, recreational, operational and mission support buildings, and buildings that support the flight line. No buildings are located at the MRS. No cultural resources are identified within the MRS.

2.3.9 Current and Future Land Uses

FI857a MRS is currently unused and no future land use changes are anticipated. There is no fencing or other controls associated with the FI857a; however, access to Holloman AFB requires admittance through the security gate and there is a fence around the installation. Therefore, access to this site is restricted for the general public, but is open to Base personnel, contractors, and Base residents. Trespassers can also access the area.

2.4 Previous Investigations

MMRP investigations conducted at the MRA 857 include:

- Modified CSE Phase I (Shaw Environmental, Inc., 2010), and
- CSE Phase II (HDR, 2013).

2.4.1 Modified CSE Phase I

Modified CSE Phase I was completed in 2010. Prior to the start of the CSE Phase I, no MRAs had been discovered at Holloman AFB and it was believed that there was a low probability of a significant number of MRAs being found at the Base. Therefore, the USAF has modified the CSE Phase I process by deferring some actions typically performed in a Phase I, to the CSE Phase II, if a Phase II is required. For this Modified CSE Phase I, it was determined that a Conceptual Site Model, Munitions Response Site Prioritization Protocol (MRSPP), and Hazard Ranking System scoring elements were not required. The activities performed during the CSE Phase I included identification and review of data repositories located both on and off the installation, interviews with Base personnel, and visual surveys.

Modified CSE Phase I investigation at the Former Bunker MRA 857 included a visual survey. No evidence of MEC/MPPEH was identified. The remains of a wooden platform, wood debris, and piles of lumber were observed at the MRA.

2.4.2 CSE Phase II

A CSE Phase II investigation was performed at the Former Bunker MRA 857 in 2012. The visual survey was conducted to identify the location and features of the area as well as to determine whether evidence of MEC is present at the MRA and whether Munitions Constituents (MC) (e.g., explosives) are present above regulatory screening levels (**Figure 2-3**).

Large amounts of wooden debris consistent with possible towers as well as one large rectangular area of wood debris from an unknown structure were observed during the visual survey. Two small depressions associated with wood and wire mesh debris were also documented.

Small arms debris identified at the MRA included .22, .32, 7.62 millimeter (mm), and .50 caliber casings, as well as a 7.62 mm link and a .50 cal link. MD consisting of a grenade pin, one (1) M38 practice bomb box fin, and nine (9) M38 practice bomb casings with no spotting charges present were observed at the area. These practice bombs were nearly intact with no damage and grouped together indicating that they were likely disposed of at the location. Other items of interest were four light fiberglass mock munitions, one displaying a bomb lug, lying near a wire mock aircraft. One (1) flight controller box, possibly from a drone aircraft, was also documented at the MRA. No MEC source was identified during the visual survey; therefore, no samples were collected for explosives analysis.

Thirty seven (37) surface soil samples were collected and analyzed for lead using X-Ray Fluorescence (XRF) (**Figure 2-4**). Lead analysis results ranged from below the Level of Detection (LOD) (12 milligram (mg)/kilogram (kg) to 24 mg/kg. Of the 37 samples collected, 18 were below the LOD (12 mg/kg). No samples exceeded the screening level of 400 mg/kg. Soil samples from twelve (12) XRF locations (high, medium, and low concentrations in the data range, per Method 6200) from different CSE Phase II MRAs were sent for off-site laboratory analysis to evaluate the accuracy of the XRF analytical method. Out of these twelve (12) correlation samples one sample was taken from the MRA 857. The XRF and lab analytical results were plotted and compared using a linear regression process to measure slope. The correlation analysis based on all twelve (12) samples showed that data collected at the MRA 857 were acceptable for risk assessment purposes.

Based on results from the human health risk assessment it is unlikely that lead is associated with potential risks to current or future receptors at the MRA 857. Maximum and mean lead

concentrations exceeded the Ecological Soil Screening Level for only the most sensitive receptor category, and were less than the 50th percentile lead background concentration for the western United States as reported in USEPA, 2005. Therefore, lead does not pose a potential ecological risk at the Former Bunker MRA.

Based on CSE Phase II visual survey results the MRA 857 was split into two MRSs: FI857 Former Bunker (19.8 acres) and FI857a Former Bunker (0.8 acres). MEC and MC above the level of concern were not identified at both sites; however, FI857a contains surface MD (**Figure 2-3**).

Both sites FI857 and FI857a were prioritized based on relative risk, using the MRSPP scoring system. The MRS Priority is determined by selecting the highest rating from the Explosives Hazard Evaluation, Chemical Hazard Evaluation, and Human Health Hazard Evaluation modules and ranges from 1 to 8. Priority 1 and 8 indicate the highest and the lowest potential hazards, respectively. Only a site with a chemical warfare hazard can receive an MRSPP Priority of 1. FI857 obtained an MRSPP score of 8 and was recommended for NFA, while FI857a obtained an MRSPP score of 7 and was recommended for further munitions response action. Therefore, this EE/CA is developed for FI857a MRS.

2.5 Streamlined Risk Evaluation

2.5.1 MEC Exposure Pathway Analysis

The MEC Exposure Pathway Analysis for FI857a MRS is shown in **Figure 2-5.** Based on the CSE Phase II results, the potential for MEC/MPPEH at the FI857a MRS was found in the form of MD associated with M38 practice bombs and hand grenades (pin only).

A variety of naturally occurring processes may alter the condition of the land at the site resulting in a potentially explosive subsurface item being exposed at the surface and becoming more accessible to contact with people or the environment. These processes may include frost heave, flooding and erosion. A variety of intrusive activities by people also may alter the condition of the land at the site in a manner that a subsurface MEC item may become exposed at the surface. These may include construction activities that involve excavation.

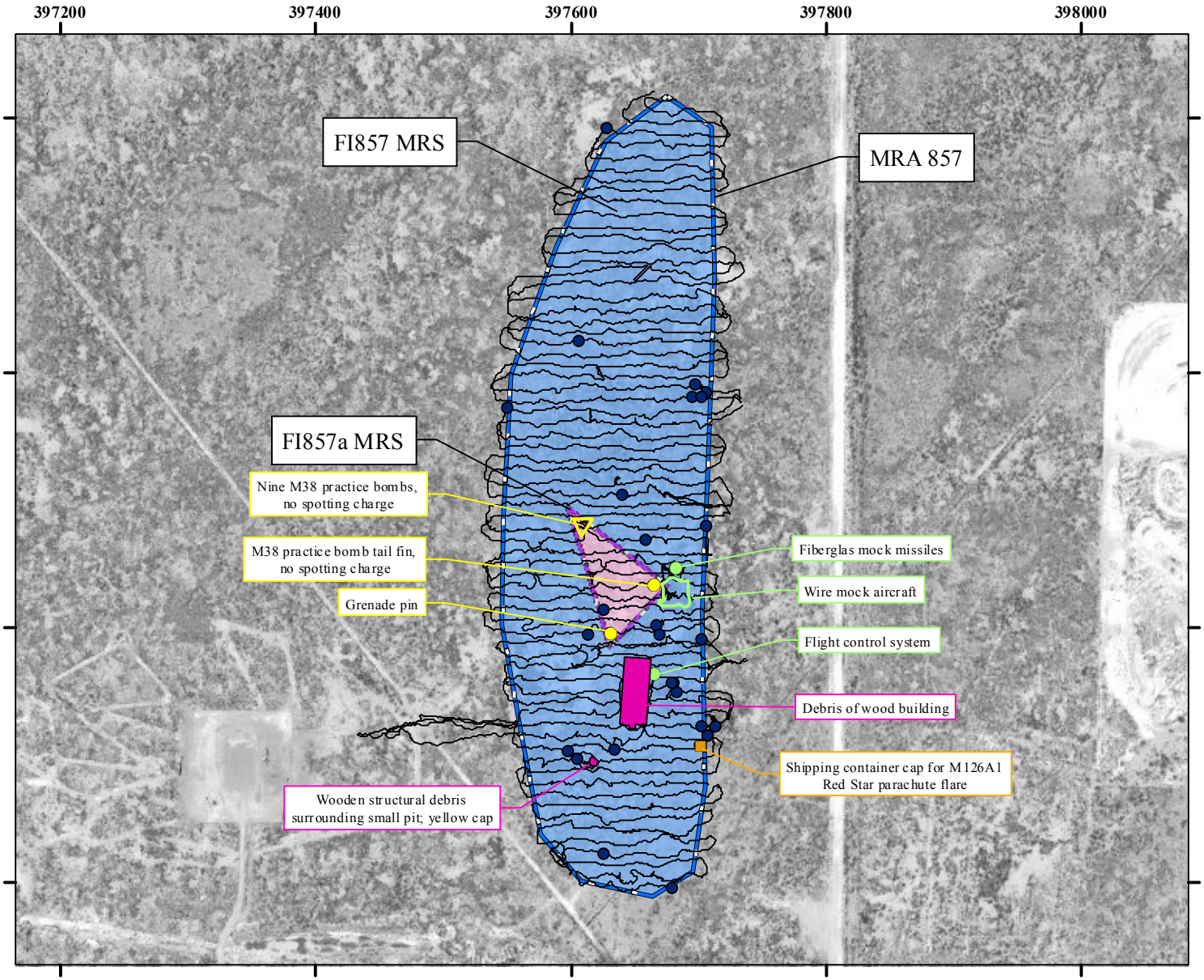
The FI857a MRS is accessible by human receptors, including Base personnel, Base residents, and contractors; and may be accessible to trespassers. Exposure pathways are shown to be incomplete for all of these receptor categories for MEC on the both soil surface and subsurface.

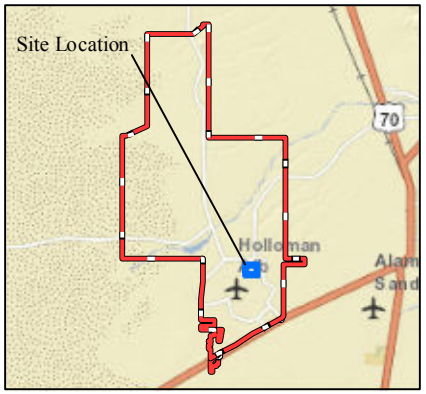
Biota are generally not considered when evaluating MEC risk because, with the exception of threatened and endangered species, risk to biotic receptors is usually evaluated at the population level. Though an individual ecological receptor may experience a negative affect from encountering MEC, MEC does not pose risk to biotic populations unless a large area of habitat were to be destroyed, for example, by a large detonation. Since rare, threatened or endangered species are not expected to inhabit the FI857a MRS, MEC exposure pathways to biota are shown as incomplete.

2.5.2 MC Exposure Pathway Analysis

MC Exposure Pathway Analysis for FI857a MRS is shown in **Figure 2-6**.

In general, migration pathways involve movement via air, water, soil, and the interfaces between these media. Based on the types of releases and the characteristics of MC/Contaminants of Potential Concern (COPCs), the fate and transport of contaminants at Holloman AFB is expected





Legend

- Munitions Debris
- Training Item
- Small Arms Debris Casing
- Range-Related Debris
- Completed Visual Survey Transects
- Training Item
- Munitions Debris
- Wood Building Footprint
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-3

CSE Phase II Visual Survey Results
Former Bunker MRA

NOTES:
Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 400 feet

0 60 120 Meters

0 200 400 Feet

N W E S

FPM Remediations, Inc.

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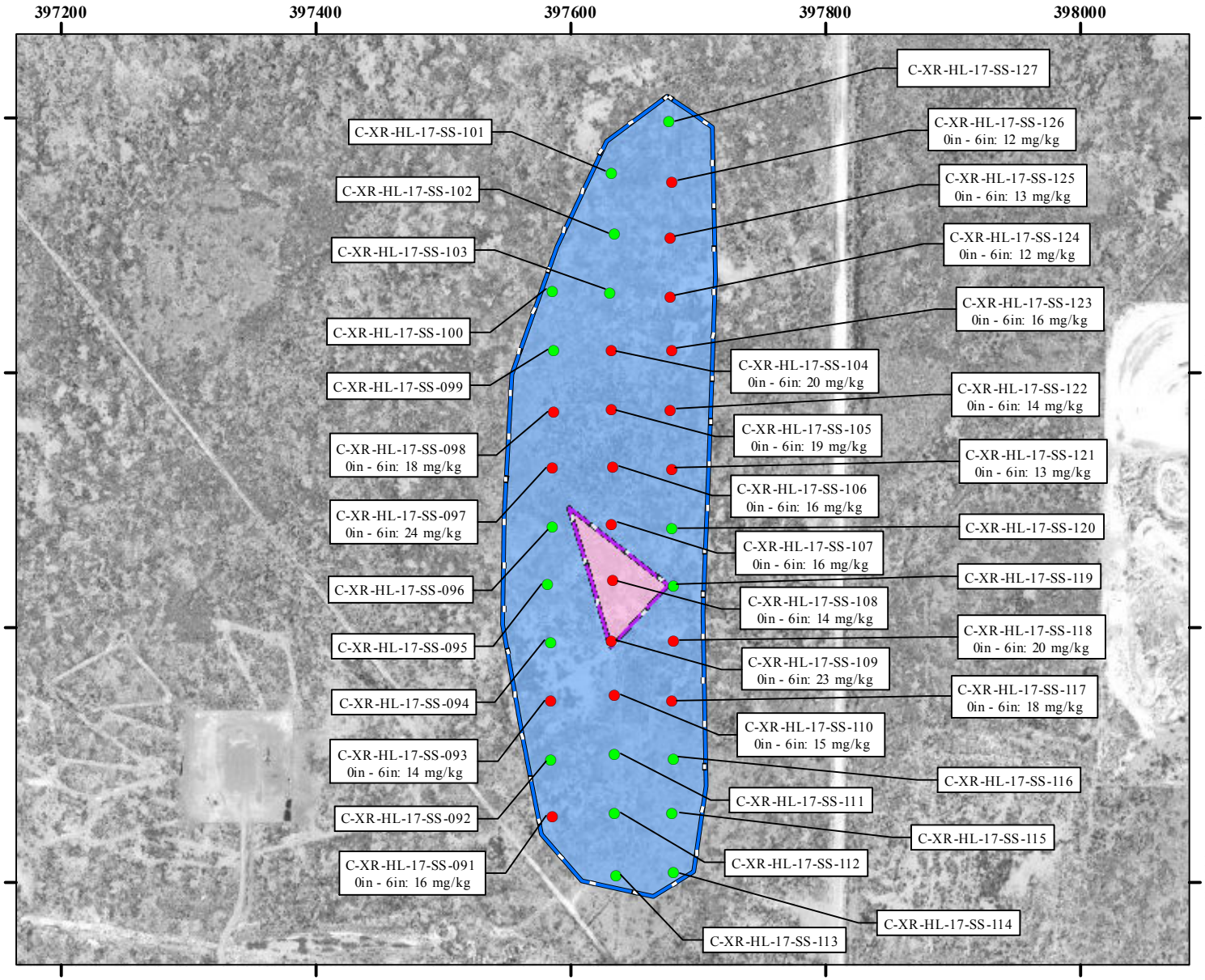

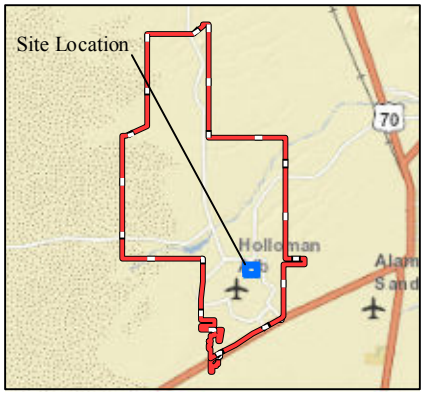

Legend

- Lead Concentration < LOD
- Lead Concentration > LOD
- Former Bunker MRA 857 (20.6 acres)
- FI857a Former Bunker MRS (0.8 acres)-EE/CA
- FI857 Former Bunker MRS No Further Action (19.8 acres)
- Installation Boundary

Performance Based Remediation
New Mexico-Arizona
Holloman Air Force Base
Alamogordo, NM

AFCEC

FIGURE 2-4

XRF Lead Sample Results
Former Bunker MRA

NOTES:
Revision Date: 4/8/2014

Coordinate System:NAD 1983 UTM Zone 13N
Projection: Transverse Mercator
Horizontal Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -105.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
Base Map Date: (c) 2010 Microsoft Corporation and its data suppliers
Base Map Source: ESRI Online Bing Data Source

1 inch = 400 feet
0 60 120 Meters
0 200 400 Feet

N W E S

FPM Remediations, Inc.

2014 page 2-13

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to occur mainly in the terrestrial environment, but there is potential for migration by aquatic and atmospheric pathways as well.

In the terrestrial environment, if the contaminant is released to soil, it may volatilize, adhere to the soil by sorption, leach into the groundwater with precipitation, or degrade due to chemical (abiotic) or biological (biotic) processes. If the contaminant is volatilized from soil, it may be released to the atmosphere or migrate to groundwater. Constituents that are dissolved in groundwater may eventually be transported to a surface aquatic environment. There are no known aquatic environments present within the FI857a MRS. Therefore, this pathway is believed to be incomplete.

In the atmospheric environment, contaminants may exist as vapors or as suspended particulate matter. The transport of contaminants relies mostly on wind currents, and continues until the contaminants are returned to the earth by wet or dry deposition. Degradation of organic compounds in the atmosphere can occur due to direct photolysis, reaction with other chemicals, or reaction with photochemically generated hydroxyl radicals. Based upon the data collected during CSE Phase II activities, transport of MC/COPCs via the atmospheric environment is unlikely at Holloman AFB and therefore at FI857a as well.

Human receptors at FI857a include authorized personnel, contractors, Base residents, and possibly trespassers. The exposure pathways include direct (or incidental) ingestion of soil, dermal contact with soil, and inhalation of volatiles and fugitive dusts from contaminated soil. The exposure pathways are shown to be complete for all of these receptor categories for MC at surface. The exposure pathways are shown to be incomplete for MC in the subsurface for all human scenarios.

Ecological receptors at this site include terrestrial invertebrates, plants, and terrestrial birds, mammals, and reptiles. MC exposure pathways to biota are shown as complete at surface and incomplete at subsurface for FI857a.

There is no present-day human exposure to groundwater at Holloman AFB. The aquifer below Holloman AFB is an unconfined sole source brackish aquifer, with an average depth to groundwater of 5 to 50 ft bgs. Groundwater flow beneath the installation generally occurs from the northeast to the southwest, and depths to groundwater tend to be shallowest toward the main installation. Depending on future land use, there is a possibility that groundwater supply wells could be put in place for domestic and/or industrial uses, though the high total dissolved solids in the aquifer indicates that the water would likely need pretreatment before it was considered potable. Therefore, exposure pathways are shown to be incomplete for MC in ground water for all receptors at the FI857a MRSs.

Figure 2-5 FI857a MRS MEC Exposure Pathway Analysis

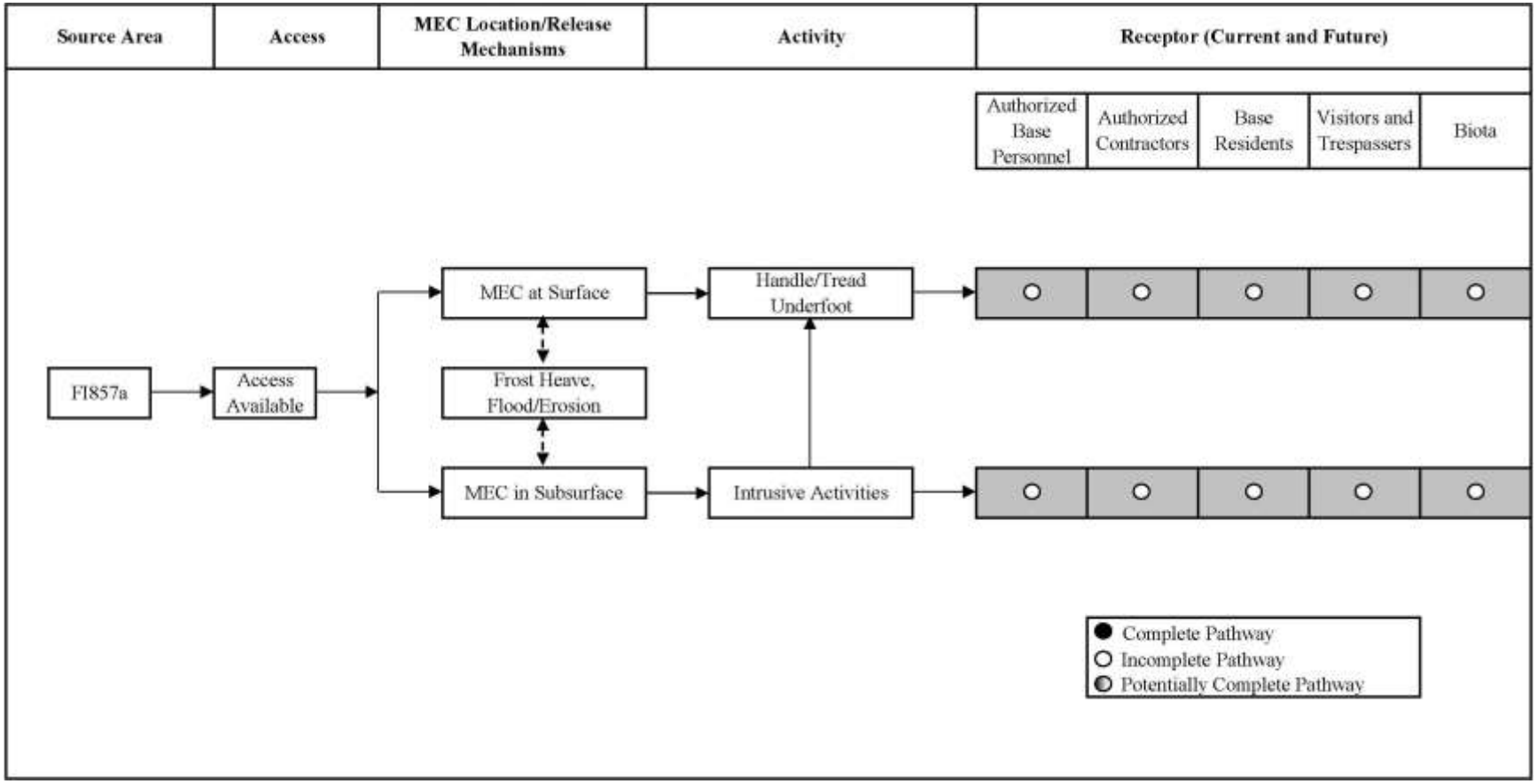
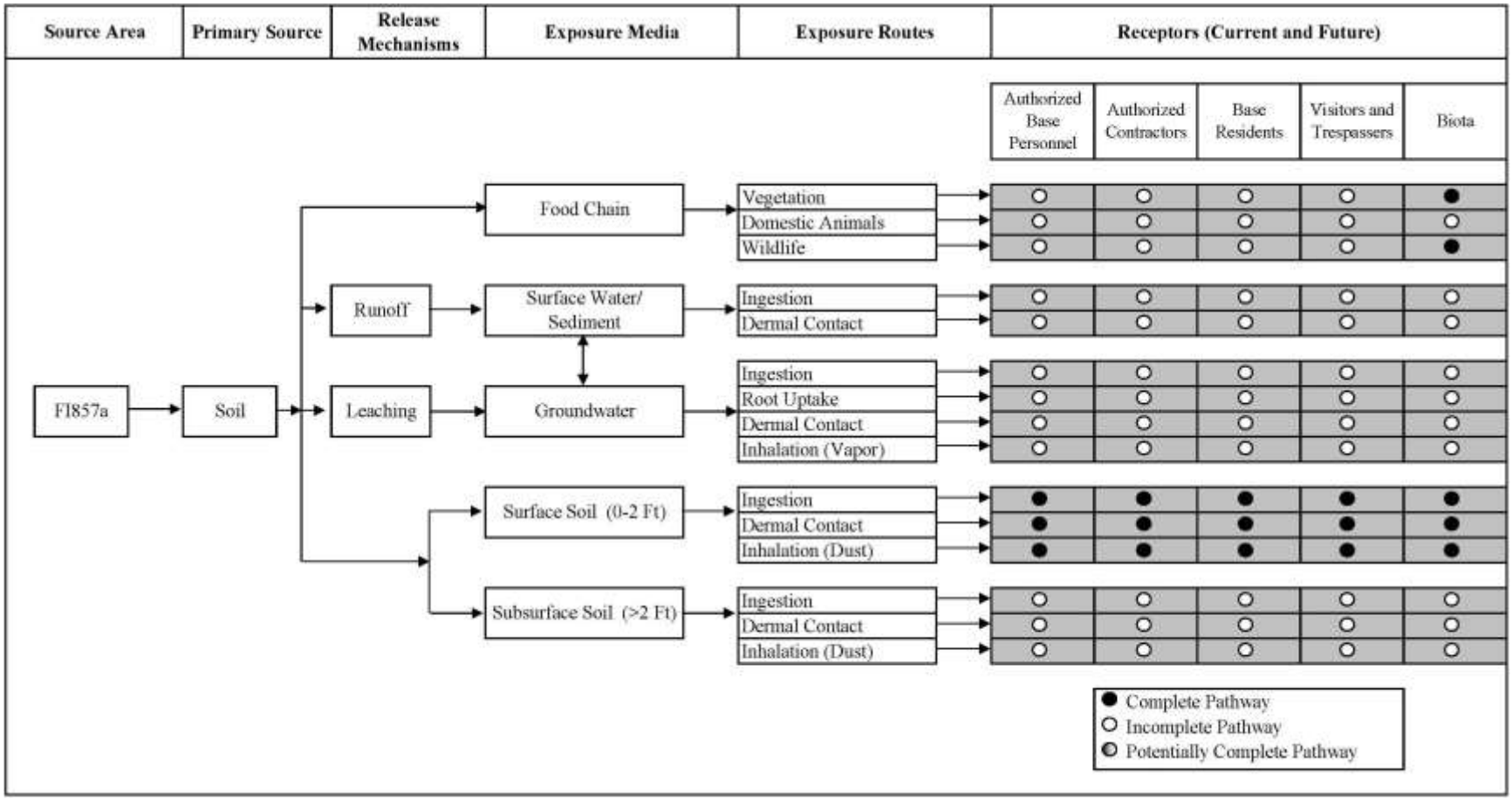


Figure 2-6 FI857a MRS MC Exposure Pathway Analysis



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3.0 DEVELOPMENT OF REMOVAL ACTION OBJECTIVES

The following sections discuss the justification for the RA, the ARARs, and the specific RAOs developed for the NTCRA at the FI857a MRS.

3.1 Justification For the Proposed Removal Action

The MEC/MPPEH potentially present on the surface and subsurface of the ground poses a potential and avoidable threat to human health and welfare. The removal of these items would reduce risk/hazards suspected to be present due to historic use of the property. Threats to human health or the environment, though not time-critical, are sufficiently serious that conditions at FI857a MRS meet the USEPA 40 Code of Federal Regulations (CFR) § 300.415(b)(2)(vi) - threat of fire or explosion - criterion for initiating an RA.

3.2 Applicable or Relevant and Appropriate Requirements

The ARARs addressing contaminated environmental media are identified in this section. The NCP (40 CFR 300.5) defines "applicable" requirements as: "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site." Only those promulgated state standards identified by a state in a timely manner that are substantive and equally or more stringent than federal requirements may be applicable.

The NCP (40 CFR 300.5) further defines "relevant and appropriate" requirements as: "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site." Like "applicable" requirements, the NCP also provides that only those promulgated state requirements identified in a timely manner and are more stringent than corresponding federal requirements may be relevant and appropriate.

USEPA identifies three basic types of ARARs. They include the following: chemical-specific, location-specific, and action-specific.

- Chemical-specific ARARs are generally health- or risk-based values that, when applied to site-specific conditions, result in numerical values. These values establish the acceptable concentration of a chemical that may be found in, or discharged to, the ambient environment.
- Location-specific ARARs are restrictions placed upon removal activities of hazardous substances solely because they are occurring in a particular place.
- Action-specific ARARs are generally technology or activity-based requirements on actions taken with respect to hazardous substances. These requirements are triggered by the particular activities that are selected to accomplish a remedy. Thus, action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. MEC/MPPEH RA will be conducted in compliance with Department of Defense (DoD), USAF, and U. S. Army

Corp of Engineers (USACE) explosive safety standards and munitions response procedures.

3.2.1 Chemical Specific ARARs

There are no chemical-specific ARARs associated with MEC.

3.2.2 Location-Specific ARARs

Location-specific ARARs set restrictions on the types of activities that can be performed based on site-specific characteristics or location. Alternative actions may be restricted or precluded based on proximity to wetlands or floodplains, presence of natural or cultural resources, or to man-made features such as existing disposal areas and local historic buildings. No location-specific ARARs guidance was identified. Final location-specific ARARs (statutes and regulations) will be determined in consultation with the USEPA, New Mexico Environment Department (NMED), and other appropriate federal and/or state agencies. These agencies are responsible for administration of programs that implement the potential location-specific ARARs.

3.2.3 Action-Specific ARARs

Based on the RA alternatives developed to address MEC at the FI857a site, certain action-specific ARARs will be considered. The action-specific ARARs are presented in **Table 3-1**. At present, New Mexico regulates military munitions through CERCLA. In addition, an RA plan approved by NMED must incorporate all substantive requirements of state law, including public participation and review, compliance with state laws and regulations, and all other technical elements to ensure protection of public health and the environment.

3.3 Removal Action Objective

Based on the NCP requirements and the applicable ARARs previously discussed, the following RAO was developed for the NTCRA at the FI857a MRS:

- Implement measures within FI857a that will minimize explosives hazards associated with MEC/MPPEH that pose a potential explosives safety risk to Base personnel, contractors, and Base residents.

Table 3-1 List of Potential Action-Specific ARARs

Standard, Requirement, or Criteria	Description	Comment
FEDERAL		
Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act of 1976 (42 U.S.C. Sect. 6901-6992K)		
Standards Applicable to Generators of Hazardous Waste (Subtitle C) (40 CFR Part 262)	Establishes standards for generators of hazardous waste.	Applicable if RA involves off-site disposal or treatment of hazardous waste. On-site generation triggers selected provisions (i.e., waste determination, accumulation time).
Standards Applicable to Transporters of Hazardous Waste (Subtitle C) (40 CFR Part 263)	Establishes standards which apply to persons transporting hazardous waste within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	Applicable if RA involves off-site transportation of hazardous waste.
Standards for the Management of Specific Hazardous Wastes and Specific types of Hazardous Waste Management Facilities (40 CFR Part 266)	Establishes requirements which apply to recyclable materials that are recovered or disposed on the land.	Applicable as recovered MPPEH certified as Material Documented as Safe (MDAS) would be recycled as appropriate.
Clean Water Act (33 USCA Sect. 1251-1376)		
National Pollutant Discharge Elimination System (40 CFR Parts 122.26(b)(14)(x))	Requires that storm water runoff be monitored and controlled on construction sites greater than one acre.	Applicable for remedial actions that involve vegetation removal that could result in storm water runoff.

Standard, Requirement, or Criteria	Description	Comment
Clean Air Act, as amended 42 U.S.C. Sect. 7401-7671Q		
Approval and promulgation of Implementation Plans 40 CFR 52, Subpart T, Louisiana	Establishes Air Quality Control Regions and attainment dates for national standards in those regions.	Applicable for remedial activities that involve air emissions (including dust particulates) e.g., excavation.
Hazardous Materials Transportation Act (49 U.S.C. Sect. 1801-1813)		
Hazardous Materials Transportation Regulations (49 CFR Parts 107, 171-177)	Regulates transportation of hazardous materials.	Applicable if the remedial action involves transportation of hazardous materials.
U.S. Department of Transportation Regulations (49 CFR Parts 170-179)	Establishes regulations for the transportation of hazardous materials by private, common, or contract carriers by motor vehicle.	Applicable if the remedial action involves transportation of hazardous materials.
Occupational Safety and Health Act of 1970 PL 91-596; 29 USCA Sect. 651-678		
Occupational Safety and Health Standards (29 CFR Part 1910)	Establishes safety and health requirements for personnel working with hazardous materials and hazardous waste.	Applicable to on-site remedial activities.
Safety and Health Regulations for Construction (29 CFR Part 1926)	Establishes protection standards (e.g., hazard communication, excavation and trenching requirements) for workers involved in hazardous waste operations.	Applicable to on-site remedial activities.

Standard, Requirement, or Criteria	Description	Comment
Work Plans (WPs) MMRP-09-001 (USACE, 2009a)	WPs will be used to describe the goals, methods, procedures, and personnel used for field activities for all munitions response remedial or removal responses and other munitions related actions.	TBC for all alternatives that will require potential interaction with MEC/Material Documented as an Explosive hazard (MDEH) or MD.
Explosives Management Plan MMRP-09-002 (USACE, 2009b)	The Explosives Management Plan will be used to provide details for management of explosives for a specific munitions response or other munitions related project IAW applicable regulations. This Data Item Description contains the instructions for preparing WP chapters addressing explosives management for specific MR or other munitions related projects.	To be Considered (TBC) to those alternatives that may encounter MPPEH as part of remedial process.
Safety Submissions MMRP-09-003 (USACE, 2009c)	The Explosives Safety Submission (ESS) is used to provide the appropriate safety criteria for planning and siting of operations for munitions response, Recovered Chemical Warfare Material and other related projects that are in an investigative or characterization phase where there will be intentional physical contact with MPPEH, or presenting a chemical hazard.	TBC to those alternatives that will require removal of MEC/MPPEH as part of the remedial process.
Accident Prevention Plan MMRP-09-005 (USACE, 2009d)	Instructions for preparing an Accident Prevention Plan for conventional ordnance and explosives projects.	TBC to those alternatives that will require removal of MEC/MPPEH as part of the remedial process.

Standard, Requirement, or Criteria	Description	Comment
EE/CA, Remedial Investigation (RI) and Feasibility Study (FS) Reports MMRP-09-010 (USACE, 2009e)	The EE/CA Report, the RI Report and the FS Report are used to document the methods employed during site characterization and present the results of the site characterization, an analysis of response action alternatives, and the recommended response alternative. This DID provides the requirements for preparing these reports as part of the MMRP response process and other munitions related actions.	Portions of this guidance are TBC to the completion of this EE/CA.
Accident / Incident Reports MMRP-09-011 (USACE, 2009f)	The Accident/Incident Reports will be used for reporting accidents/ incidents that occur on the work site or in connection with the stated work of this contract.	TBC. Any accidents or incidents that occur during the implementation of remedial alternatives will need to be reported accordingly.
Personnel Qualifications Certification Letter MMRP-09-012 (USACE, 2009g)	The Personnel Qualifications Certification Letter is submitted by the contractor certifying that key personnel and personnel filling core labor categories meet the training and experience requirements for the position held. Resumes will be used to document personnel qualifications and experience.	TBC. Proof of training would be maintained for all Unexploded Ordnance (UXO) personnel that would work on the site in various capacities in accordance with the work required for the alternatives presented in this EE/CA. Use of properly trained personnel is required by MMRP guidelines.
Implementation of Department of Defense Explosives Safety Board (DDESB) Guidance on Minimum Separation Distances for Unintentional Detonations (DDESB, 2013)	The USACE has endorsed the use of the Hazard Fragmentation Distance for determining the minimum separation distance for unintentional detonations for MMRP responses/ projects for all MEC/MDEH	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.

Standard, Requirement, or Criteria	Description	Comment
USAF, MEC Hazard Assessment Tool (MHAT) Methodology (USAF, 2011)	This document describes the MHAT methodology for assessing potential explosive hazards to human receptors at MRS. The MHAT allows a project team to evaluate the potential explosive hazard associated with an MRS, given current or reasonably anticipated future conditions, and under various cleanup, land use activities, and Land Use Control (LUC) alternatives.	TBC for all alternatives that will involve LUCs, surface clearances, and/or subsurface clearances.
USACE Engineering and Design Military Munitions Response Actions; Engineer Manual (EM) 1110-1-4009 (USACE, 2010)	This manual provides USACE procedures to be used to perform engineering and design activities for all phases of the MMRP.	TBC for engineering and design activities under the MMRP.
USACE Safety and Health Requirements Manual; EM 385-1-1 (USACE, 2011)	This manual prescribes the safety and health requirements for all USACE activities and operations.	TBC for all on-site remedial activities.
USACE Explosives Safety and Health Requirements Manual; EM 385-1-97 (USACE, 2013)	This manual prescribes the safety and health requirements for all USACE activities and operations that involve explosives related work.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.
Air Force manual 91-201; Explosives Safety Standards (USAF, 2011)	These standards establish a central source for explosive safety criteria. It identifies hazards and states safety precautions and rules when working with explosives.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.

Standard, Requirement, or Criteria	Description	Comment
DoD Ammunition and Explosives Safety Standards; 6055.09-M (DoD, 2009)	These standards are designed to manage risks associated with DoD-titled ammunition and explosives by providing protection criteria to minimize serious injury, loss of life, and damage to property.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD.
Department of Defense Instruction 4140.62, Material Potentially Presenting an Explosive Hazard (DoD, 2008)	This instruction provides policy and responsibilities for the management and disposition of MPPEH.	TBC for all alternatives that will require potential interaction with MEC/MDEH or MD
STATE		
NMED New Mexico Administrative Code Title 20 Chapter 9	Applies to the transportation, storage, transfer, processing, recycling, composting, nuisance abatement and disposal of solid waste.	Applicable for remedial actions that involve recycling of solid waste or disposal of solid waste at an approved off-site landfill.
New Mexico Statutes and Codes Chapter 74 – Environmental Improvement.	Establishes a department that will be responsible for environmental management.	Applicable for remedial actions that involve waste management and cleanup.
NMED New Mexico Administrative Code Title 20 Chapter 2 Part 1 and 75	Fugitive emissions fee A fee that specifically allows fugitive dust producing operations or activities is responsible for controlling windblown dust from earthmoving and other activities.	Potentially applicable to fugitive dust emissions during excavation, backfilling, and landscaping activities.
NMED New Mexico Administrative Code Title 20 Chapter 2 Part 7	General Provisions Emission of an air contaminant, including a fugitive emission, in excess of the quantity, rate, opacity or concentration specified by an air quality regulation or permit condition.	Potentially applicable to fugitive dust emissions during excavation, backfilling and landscaping activities.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section identifies and describes the RA alternatives that address the RAO for the FI857a MRS. The RA alternatives were developed by combining the most qualified General Response Actions (GRAs) that have been selected in the past at sites with similar conditions. The main objective of development of different alternatives is to provide decision-makers with an appropriate range of options and sufficient information to adequately compare alternatives against one another.

4.1 General Response Actions

The GRAs are broad classes of medium-specific actions such as no action, LUCs, surface removal, subsurface removal, or a combination of these that will achieve the RAO. The GRAs can be implemented through different remedial technologies and process options, defined as follows:

- Remedial technologies are the general categories of remedies such as detection, removal, disposal, and access restrictions;
- Process options are specific categories of remedies within each remedial technology, and are used to implement each remedial technology.

4.1.1 Identifications of Technologies and Process Options

The GRAs with corresponding remedial technologies and process options that were used for development of RA alternatives for FI857a MRS are summarized in **Table 4-1** and described as follows:

- **No Action** – No remedial action would be taken to address the potential MEC/MPPEH, MD, or range related debris hazards.
- **LUCs** – This GRA includes access restrictions and educational programs. In general access restrictions may include installing and maintaining fencing around controlled areas, posting warning signs prohibiting entry, or implementing zoning, planning or deed restrictions. In addition, as part of this alternative, administrative controls (including anomaly avoidance measures and UXO Construction Support) and deed restrictions would be implemented that could include stipulation that property could be used only for surface activities. Construction support would include a qualified UXO team, usually consisting of a minimum one UXO Technician Level III and one UXO Technician Level I, provides MEC avoidance by escorting site users in high risk areas and observing grading or other construction activities. The UXO team would halt all activities if MEC is encountered. For excavation activities in the MRS, this process option would likely require UXO personnel conducting an RA to the maximum excavation depth or the maximum penetration depth prior to excavation activities. Zoning/planning could be implemented to control the designated land use (agricultural, etc.). Educational programs would be tailored to community needs and could include public meetings, distribution of fact sheets, exhibits, videos, and educational signage at the MRS.
- **Surface MEC/MPPEH Removal –** Removal of MEC/MPPEH from the entire surface of the MRS. Analog metal detectors (e.g., Whites all metal detectors) and magnetometers (e.g., Schonstedt) would be used to provide instrument assistance in identifying metal items

exposed at the surface. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the DDESB Guidance for Clearance Plans (DDESB, 1998), and the USACE Military Munitions Response Actions, EM 1110-1-4009 (USACE, 2010). All recovered MD and other metallic cultural debris items would be moved to a central location inspected, certified as MDAS. MEC/MPPEH (determined as MDEH would be destroyed by detonation using Blow-in-Place (BIP) or consolidated detonation procedures. BIP is the destruction of MEC for which the risk of movement beyond immediate vicinity of discovery is not considered acceptable. Normally, this is accomplished by placing an explosive charge alongside the item. Waste streams generated from BIP operations may fall under further regulatory guidance with respect to treatment and/or final disposition. Consolidated Detonations are defined as the collection, configuration, and subsequent destruction by explosive detonation of MEC for which the risk of movement has been determined to be acceptable either within a current working sector or at an establish demolition ground. This option has an increased risk associated with handling and transporting live MEC, and requires oversight by specially trained UXO technicians or Explosive Ordnance Disposal (EOD) personnel and restricted access during detonation. EOD and other applicable organizations require notification of detonation activities. All MDAS would be transported from the site to an alternate off-site location for disposal/recycling.

- **Subsurface MEC/MPPEH Removal -** Removal of subsurface anomalies, potentially representing MEC/MPPEH, to a depth based on the anticipated penetration of suspected munitions or technology limitation. The most common digital detection technologies considered for detecting and mapping subsurface anomalies are electromagnetic induction sensors (e.g., Geonics EM61-MK2 [EM61] and magnetometers (e.g., Geometrics G-858 Cesium Vapor Magnetometer [G-858]). In general, G-858 represents a more robust system for detecting and mapping munitions of interest at greater depths than EM61. The detection capabilities of magnetometers and electromagnetic induction sensors are not anticipated to be impacted by site geology or anthropogenic sources. This should be confirmed with use of Instrument Verification Strip (IVS)/Geophysical System Verification (GSV). Demolition operations of discovered MEC/MPPEH and disposal operations of MDAS would be performed within this response action as described for Surface MEC/MPPEH Removal.

4.2 Alternative Description

The following four RA alternatives were developed for FI857a MRS by combining the GRAs summarized in **Section 4.1**:

5. No Action,
6. LUCs,
7. Surface Removal of MEC/MPPEH Combined with LUCs, and
8. Surface and Subsurface Removal of MEC/MPPEH.

A description of each of these alternatives is provided below

4.2.1 Alternative 1 - No Action

The No Action alternative involves no action to be performed under current or future land-use scenarios. No RA would be performed at the site, and no institutional controls such as warning

signs or land use restrictions are included in the No Action alternative. No cost will be associated with this alternative. This alternative is included as a baseline comparison for other alternatives.

Table 4-1 Potentially Applicable MEC Technologies and Process Options at FI857a MRS

General Response Action	Remedial Technology	Process Option
No Action	None	None
LUCss	Access Restrictions - Administrative Controls	Zoning, Planning and/or Deed Restrictions
		Educational Awareness Program
		UXO Escort/Construction Support
	Access Restrictions - Engineering/Physical Controls	Fencing
		Signage
Surface MEC/MPPEH Removal	Detection	Analog Metal Detectors
	Removal	Manual Removal Methods (Shovels, Hand Equipment)
	Disposal	MPPEH Inspections
		Demolition (MEC/MDEH)
		Manual Demilitarization (If Required)
		MDAS Disposal (Recycling)
Subsurface MEC/MPPEH Removal	Detection	Digital Metal Detectors
	Removal	Manual Removal Methods (Shovels, Hand Equipment)
		Mechanical Methods (Earth Moving Machinery)
	Disposal	MPPEH Inspections
		Demolition (MEC/MDEH)
		Manual Demilitarization (If Required)
		MDAS Disposal (recycling)

4.2.2 Alternative 2 - Land Use Controls

The LUCs alternative includes engineering controls (e.g., fencing and warning signage) and institutional controls (e.g., military orders preventing access to the MRS). Based on the suspected presence of MEC/MPPEH at FI857a MRS, the site's proximity to populated areas, and

the relative ease of access for Base personnel and residents, engineering controls including physical barriers and signage would be required. As part of this alternative, fencing would be placed along the perimeter of the site and frequent signage would be put in place. The fencing would be constructed of 7-foot high chain link topped with barbed wire and would be constructed to restrict access to entire site. Signs identifying the area as having a MEC hazard would be placed every 100 ft along the fence line. Intrusive work would be required during fence installation; therefore, MEC avoidance would be required. An estimated 919 linear ft of fence and 10 warning signs would be installed as part of this alternative. If Holloman AFB transfers the land associated with the FI857a MRS, then LUCss including restrictions and a description of hazards present at the MRS would need to be incorporated into any real property documents necessary for transferring ownership from Holloman AFB.

4.2.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs

The instrument-aided removal of all visible MEC/MPPEH would be performed in this alternative. The hand-held magnetic locators would be utilized during this effort. The use of metal detectors for surface clearance would not be warranted since non-ferrous munitions are not suspected to be present on the site Following the completion of the surface clearance, brush clearing would be conducted across the entire area of the MRS. Brush clearing would be performed using hand or powered tools such as machetes, brush hooks, or powered circular saw type weed cutters. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the guidance set forth in the DDESB-approved ESS developed for the FI857a MRS. Discovered MEC/MPPEH (determined as MDEH) would be detonated on-site, and all remaining MD and other metallic cultural debris items would be moved to a central location and shipped to a recycling facility for disposal. Range related features would be removed except for the large range related structures that would be left in place.

Surface soil samples would be collected from areas containing isolated locations of confirmed MEC/MPPEH and in areas of significant amounts of MD using composite soil sampling techniques to determine the presence or absence of MC contamination (metals and explosives). In addition, MC soil sampling would be performed before and after BIPs and consolidated shots. The NMED has recently revised its risk based Soil Screening Levels (SSLs) (NMED, 2012). USEPA also publishes Regional Screening Levels (RSLs) (USEPA, 2013). The more conservative of these two values (SSL and RSL) would be used as the risk-based screening level to determine whether MC contamination exists.

LUCs would be implemented upon completion of surface MEC/MPPEH removal to minimize potential exposure to potential subsurface MEC/MPPEH and to increase public awareness of the historical use and the potential for encountering MEC/MPPEH. LUCs would be comprised of educational and awareness programs for Base personnel and visitors that include but are not limited to:

- Notations of the suspected presence of subsurface MEC/MPPEH in the Base Real Property records, in the Installation General Plan, and in the Base Geographic Information System land management system (Geobase) as well as written materials designed to raise community understanding and awareness of the hazards associated with subsurface MEC;
- Signs that warn the users of the former range of areas where they may encounter subsurface MEC.

- Already implemented dig permits at Holloman AFB prohibiting digging without construction support by UXO personnel would remain in place.

4.2.4 Alternative 4 - Surface and Subsurface Removal of MEC/MPPEH

This alternative includes 100% surface removal of MEC/MPPEH and removal of the following subsurface anomalies:

- Those that show characteristics of burial pits and
- All individual geophysical anomalies above the established threshold based on the MRS background noise determined by an IVS/GSV.

In no case will any excavations and removals exceed 10 feet. In addition, if perimeter anomalies are found or if surface clearance and/or intrusive investigation results indicate the MEC/MPPEH presence beyond the MRS boundary, FPM will extend surface clearance and DGM investigation to determine the extent of contamination.

The MRS would undergo a 100 percent (%) surface clearance as outlined for Alternative 3 and a 100% Digital Geophysical Mapping (DGM) coverage using magnetometer G-858 coupled with the Real-Time Kinematic Global Positioning System. The suspected munition items for FI857a MRS are grenades and M38 practice bombs. Both the M38 bomb and hand grenade are composed of ferrous metal components which makes both electromagnetic induction sensors (EM61) and magnetometers (G-858) potentially appropriate for the subsurface clearance. However, since FI857a MRS had not been used as a bombing range, the anticipated MEC/MPPEH in the subsurface of the site could have been buried on site at any depth. In general, G-858 is used for detection of munitions located at greater depths; therefore, G-858 would be used for detection of subsurface anomalies.

All DGM anomalies identified for intrusive investigation would be removed using both manual removal techniques (e.g., shovels, hand equipment) and earth moving machinery. Recovered MEC/MPPEH would be handled, stored, destroyed, and demilitarized in accordance with the guidance set forth in the DDESB-approved ESS developed for the FI857a MRS. The excavated MEC for which the risk of movement beyond immediate vicinity of discovery is not considered acceptable would be BIP. MEC for which the risk of movement has been determined to be acceptable either within a current working sector or at an establish demolition ground would be disposed by consolidated.

Surface and subsurface soil samples would be collected from areas containing isolated locations of confirmed MEC/MPPEH and in areas with significant amounts of MD using composite soil sampling techniques to determine the presence or absence of MC contamination (explosives and metals). In addition, MC soil sampling would be performed before and after BIPs and consolidated shots. The SSLs (NMED, 2012) and RSL (USEPA, 2013) would be deployed to determine whether MC contamination exists, as outlined for Alternative 3.

4.3 Evaluation Criteria

This section provides evaluation of 4 alternatives using the effectiveness, implementability, and cost criteria set forth in the NCP and the USEPA guidance for conducting EE/CAs (USEPA, 1993). The following sections provide a discussion of the pertinent evaluation criteria for each alternative.

Effectiveness

The effectiveness of a technology refers to its capability of removing the specific items in the volumes required, the degree to which the technology achieves the RAO, and the reliability and performance of the technology over time, including protection of human health and the environment, compliance with ARARs to the extent practical, long-term effectiveness and permanence, reduction in explosive safety hazard, and short-term effectiveness. As explained in **Section 3.3**, the RAO for FI857a MRS is to implement measures that will minimize MEC hazards which may contain energetic materials that pose a potential explosive safety hazard to human health and the environment. Levels of effectiveness were assessed based upon the number of effectiveness criteria that would be satisfied by each alternative. Effectiveness criteria include: protection of human health, protection of workers during implementation, compliance with chemical-, location-, and action- specific ARARs, short-term effectiveness, long-term effectiveness, and reduction in the toxicity, mobility, or volume (TMV) of contaminants.

Implementability

The ease of implementation of a technology refers to the availability of commercial services to support it, the constructability of the technology under specific site conditions, and the acceptability of the technology to all parties involved (regulators, public, owner, etc.), including technical feasibility, administrative feasibility, availability of services, support agency acceptance, and community acceptance. Levels of implementability were assessed based upon the number of implementability criteria satisfied by each alternative. Implementability criteria include: technical feasibility, administrative feasibility, and community and regulatory acceptance.

Cost

For the detailed cost analysis of alternatives, the expenditures required to complete each alternative were estimated in terms of capital costs and Post Removal Site Control (PRSC) cost. Capital costs include costs to complete initial RA activities. The PRSC costs include annual operation and maintenance for 30 years and periodic costs to perform Five-Year Reviews for 30 years. By combining the different costs associated with each alternative, a present-worth calculation for each alternative can be made for comparison. For the purposes of the cost estimate summaries (**Appendix A**), Remedial Action Cost Engineering and Requirements (RACER) was utilized to develop alternative costs. RACER is an environmental remediation/corrective action cost-estimating system developed for DoD cost-estimating use.

4.4 Individual Analysis of Alternatives

4.4.1 Alternative 1 – No Action

Effectiveness

Alternative 1 provides no additional protection to human health and the environment. Potential MEC/MPPEH would remain onsite, which would potentially expose authorized personnel/workers and Base residents to explosive safety hazards associated with MEC/MPPEH. In addition this alternative would not protect the environment from future releases of explosive-related contaminants. No risk reduction will be accomplished through this alternative.

Action-specific ARARs do not apply to this alternative. Alternative 1 does not provide any short term effectiveness at FI857a MRS as it does not limit or eliminate risks to human health and the

environment. Alternative 1 does not provide any long-term effectiveness. Since no RA is performed for Alternative 1, there is no reduction in the TMV of contaminants.

Implementability

Alternative 1 is the No Action alternative; therefore, implementability does not apply. Alternative 1 is not protective of human and ecological receptors; therefore it would not be accepted by regulators.

Cost

The total estimated cost for Alternative 1 is $0. There are no capital or PRSC costs, contingencies, or professional or technical services associated with this alternative.

4.4.2 Alternative 2 – Land Use Controls

Effectiveness

Alternative 2 provides a limited level of protection to human health and the environment at the FI857a MRS. This alternative would reduce the explosive safety risk to humans by inhibiting access to MEC/MPPEH that would remain in place; however, engineering controls cannot eliminate the potential for human exposure because of intended or unintended breeches of the installed barrier. No potential environmental benefits are realized from this alternative because munitions items would remain in place.

As with any MEC site, Alternative 2 does have worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working in areas with live munitions. All personnel working in the area will be led by UXO personnel who will provide MEC avoidance support. Establishing the engineering controls would involve intrusive activities during installation, therefore the area must be free of subsurface MEC/MPPEH prior to working in that immediate area. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-related work activities.

MEC left in place does not conflict with the ability to comply with potential action- specific ARARs, therefore, Alternative 2 is in compliance with ARARs.

Alternative 2 is effective in the short term by providing physical barriers and signage for receptor access to restricted areas. Alternative 2 provides limited long-term effectiveness. Engineering controls cannot eliminate the long term risks to human health. Fencing and signage can be compromised by trespassers, and weather and the receptors would in turn have access to restricted areas. Alternative 2 does not include the removal of on-site MEC/MPPEH; therefore the risk to human health is high if engineering controls are compromised. Long term and extensive operation and maintenance would be required to maintain fencing and signs in good repair.

Since no RA will be performed for Alternative 2, there will be no reduction in the TMV of contaminants.

Implementability

This alternative is technically feasible, administratively feasible, and services and materials necessary to implement the LUCs are readily available in the local community. This alternative is considered technically feasible because the action is achievable using readily available MEC

avoidance support services and tools. Possible constraints to implementing the LUCs would be extreme weather conditions. In the case of extreme weather conditions, the installation of the fence and warning signage would be temporarily postponed. This alternative is considered administratively feasible because there are no foreseeable obstacles to implement LUCs. There are no permits, waivers, easements, or right-of-way agreements necessary to install fence and warning signage for the MRS. All equipment, personnel, and services necessary to implement Alternative 2 are available in the vicinity of Holloman AFB.

Alternative 2 provides an adequate level of protection to human health as long as LUCs are enforced. Since this alternative will not address the removal of the hazard it is unlikely that the regulators will accept this alternative.

Cost

The total estimated cost for Alternative 2 is $381,276 (**Appendix A**). Alternative 2 includes capital costs ($45,397) for developing and implementing LUCs including institutional restrictions and engineering controls. Engineering controls include installation of fencing and warning signs. PRSC costs associated with this alternative ($335,879) include annual operation and maintenance for 30 years and periodic costs to perform Five-Year Reviews for 30 years.

4.4.3 Alternative 3 – Surface Removal of MEC/MPPEH Combined with LUCs

Effectiveness

Alternative 3 provides the moderate level of protection to human health and the environment within FI857a MRS. Authorized and unauthorized personnel accessing the site would be protected from potential MEC/MPPEH items currently on the surface and the potential release of explosive related contamination will be reduced because the MEC/MPPEH items will be removed and disposed of, as necessary. An explosive hazard that may still exist in this area due to the potential presence of subsurface MEC would be addressed through LUCs.

Alternative 3 has worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working with/around potentially live munitions. All personnel involved with the MEC/MPPEH removal would be qualified to work on a site contaminated with MEC/MPPEH and must have documented proof of qualifications. All applicable safety requirements would be followed for handling, storage, and demolition/demilitarization. To protect both the site workers and visitors to the site (authorized and unauthorized), areas where the removal is taking place would have exclusion zones established for explosive safety purposes. Only authorized personnel would be allowed in the exclusion zone during the normal working hours, however, authorized visitors would be allowed in the exclusion zone under conditions specified in the DDESB-approved ESS. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-related work activities. The methodologies to safely perform these activities would be described in the Site-Specific NTCRA WP and the Health and Safety Plan (HASP).

For Alternative 3, surface MEC/MPPEH would be removed and destroyed and all activities conducted in a manner consistent with applicable ARARs.

Alternative 3 is effective in the short term by minimizing the explosive safety risk of MEC/MPPEH by permanently removing the items from the ground surface. Alternative 3 would be effective in eliminating surface MEC/MPPEH hazards from the FI857a site. The removal of MEC/MPPEH from ground surface would eliminate exposure to potential receptors. Long-term

operation and maintenance would be required and periodic site inspections would need to be performed to identify and mitigate subsurface MEC/MPPEH that exposed at the surface.

Alternative 3 provides reduction of TMV since the surface MEC/MPPEH that are encountered during the NTCRA will be either BIP or transported to the MRS Safe Disposal Area (SDA) for demolition. Additional residuals include trace amounts of metals and potential residual explosives. An evaluation of the concentrations of these residuals following a MEC detonation would be performed.

Implementability

Alternative 3 employs technologies that have been used in full-scale applications; therefore it is technically and administratively feasible. MEC/MPPEH removal support services and tools are readily available through a number of commercial contractors.

Alternative 3 provides the moderate level of protection to human health and the environment among the four alternatives. MEC/MPPEH currently on the surface would be removed and disposed of, as necessary, and the remaining subsurface MEC/MPPEH will be addressed through LUCs. However, since this MRS is fairly small (0,8 acres), the subsurface clearance of the site will be cost-effective and will remove the need for LUCs and their maintenance for 30 years. Therefore, it is unlikely that the regulators will accept this alternative.

Cost

The total estimated cost for Alternative 3 is $454,936 (**Appendix A**). Alternative 3 includes capital costs ($22,495) for performing the surface clearance across 0.8 acres as well as developing and implementing LUCs (institutional and engineering controls). Engineering controls include installation of warning signs. PRSC costs associated with this alternative ($432,441) include annual operation and maintenance for 30 years, periodic costs to perform surface sweeps of the 10% of the MRS every five years, and Five-Year Reviews for 30 years.

4.4.4 Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH

Effectiveness

Alternative 4 provides the highest level of protection to human health and the environment within FI857a MRS. Authorized and unauthorized personnel accessing the site would be protected from MEC/MPPEH items currently on the surface/subsurface and the potential release of explosive related contamination will be minimized because the surface and subsurface MEC/MPPEH items will be removed and disposed of.

Alternative 4 has worker safety issues to address prior to implementation. The main hazard to workers during implementation associated with this alternative is working with/around potentially live munitions. All personnel involved with the MEC/MPPEH removal would be qualified to work on a site contaminated with MEC/MPPEH and would have documented proof of qualifications. All applicable safety requirements would be followed for handling, storage, and demolition/demilitarization. To protect both the site workers and visitors to the site (authorized and unauthorized), areas where the removal is taking place would have exclusion zones established for explosive safety purposes. Only authorized personnel would be allowed in the exclusion zone during the normal working hours, however, authorized visitors would be allowed in the exclusion zone under conditions specified in the DDESB-approved ESS. Worker safety would be a concern for this alternative, but is a normal, manageable component of MEC-

related work activities. The methodologies to safely perform these activities would be described in the Site-Specific NTCRA WP and the HASP.

For Alternative 4, surface and subsurface MEC/MPPEH would be removed and destroyed and all activities conducted in a manner consistent with applicable ARARs.

Alternative 4 is effective in the short term by minimizing the explosive safety risk of MEC/MPPEH by permanently removing the items from the ground surface/subsurface. Alternative 4 is effective in the long-term by minimizing the explosive safety hazard by permanently removing MEC/MPPEH from the ground surface and subsurface.

Alternative 4 provides reduction of TMV since the MEC/MPPEH that are encountered during the NTCRA will be either BIP or transported to the MRS SDA for demolition. Additional residuals include trace amounts of metals and potential residual explosives. An evaluation of the concentrations of these residuals will be performed.

Implementability

The removal of surface and subsurface MEC/MPPEH from the FI857a MRS is technically and administratively implementable. MEC removal support services and tools are readily available through a number of commercial contractors.

Alternative 4 provides the highest level of protection to human health and the environment among the four alternatives and will result in the site closeout and unrestricted land use at FI857a. Therefore, the regulatory agencies are likely to consider the Alternative 4 as the most acceptable alternative at the FI857a MRS.

Cost

The total estimated cost for Alternative 4 is $132,645 (**Appendix A**). Alternative 4 includes capital costs ($132,645) for performing surface clearance across 0.8 acres, 100% DGM coverage of the site, excavation of all anomalies above the established threshold, demolition of MEC, and offsite disposal of MDAS. Since this alternative will result in site closeout, no PRSC costs are associated with this alternative.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section presents a comparative analysis of RA alternatives for the FI857a MRS. In order to rank the alternatives, each alternative was ranked numerically from 1 to 3 for each criterion. The No Action alternative was rated as Not Applicable (NA). The alternative that was determined to be the best alternative when assessed with the criterion, received a numerical ranking of 1. The second best alternative received a numerical ranking of 2, and so forth. Once the numerical ranking was determined for the three criteria (effectiveness, implementability, and cost) the overall score was determined by adding up the individual numerical rankings for each alternative. An alternative ranked "3" for effectiveness, "1" for implementability, and "3" for cost would have an overall score of "7". The overall scores were used to arrange the alternatives in rank order, with the lowest score being ranked the highest.

5.1 Effectiveness

Table 5-1 provides the ranking of effectiveness criteria of the four alternatives. Alternative 1 does not achieve the RAO. Alternative 2, 3, and 4 have been developed because they were able to achieve RAO identified in **Section 3.0**. If the RAO is achieved, then human health and the environment are protected. Workers can be protected during implementation of all three alternatives using standard personal protective equipment and MEC detecting devices and procedures. The explosive safety risk to the human health will be minimized through the removal of MEC contamination, which, if left in place, could also potentially serve as a source of chemical environmental contamination. Therefore, Alternative 4 is more protective of the human health and the environment than Alternatives 2 and 3 because it directly addresses the explosive hazard through removing MEC/MPPEH from both surface and subsurface of the site.

All three alternatives can comply with the action-specific ARARs, which apply to the implementation of the alternatives. The subsurface RA will adhere to all regulations regarding environmentally sensitive locations, excavations, detonations, and explosives transportation, use, and storage. Therefore, subsurface removal meets more ARARs than a surface clearance or LUCs. Surface removal meets more ARARs than LUCs.

For the short term effectiveness, the LUCs alternative is ranked best because it reduces risk upon implementation, requires little time to implement, and has minimal adverse effects on the public and the environment. The surface removal alternative is ranked second best as it reduces risk upon implementation, requires less time and effort to implement than subsurface removal, and results in few public and environmental impacts. The subsurface removal alternative is ranked third because it requires more planning and has more of an impact on the environment.

For the long-term effectiveness, the subsurface removal alternative is ranked best because it would eliminate any buried MEC/MPPEH in the area. For the same reason Alternative 4 is ranked best for the reduction of TMV.

As shown in **Table 5-1**, Alternative 4 is ranked best in terms of effectiveness.

5.2 Implementability

All of the alternatives are technically and administratively feasible. Implementing Alternative 2 would be easier than implementing any of the other alternatives, from both an administrative and a technical feasibility perspective. In addition, Alternative 2 could be accomplished in a relatively shorter length of time than that required to implement an RA.

Table 5-1 Effectiveness Criteria Evaluation

Alternative	Protection of Human Health	Protection of Workers	Compliance with ARARs	Short-Term	Long-Term	Reduction of TMV	Overall Score	Rank
Alternative 1 No Action	NA	NA	NA	NA	NA	NA	NA	NA
Alternative 2 LUCs	3	1	3	1	3	3	14	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	1	2	2	2	2	11	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	1	1	3	1	1	8	**1**

From technical and administrative perspectives, implementation of a subsurface removal is the least feasible. Unlike surface removal, a subsurface removal requires excavation equipment (in addition to specially trained and qualified personnel and a means of MEC disposal, which is required for all RAs). WPs and removal reports are more difficult to document. The subsurface removal alternative generally requires more logistical and management support than the surface removal alternative and it would take more time and effort to implement than surface removal.

Considering the high MEC/MPPEH risk level, it was determined that the regulatory agencies and community are likely to consider the subsurface removal alternative as the most acceptable alternative in this area. Therefore, the subsurface removal alternative is ranked best in terms of state agency and community acceptance. Surface removal is ranked second, as state agencies and community are likely to be less enthusiastic about a clearance that does not address subsurface risks. LUCs are ranked third, as state agencies and community are likely to prefer a response action that addresses removal of the hazards.

As shown in **Table 5-2,** all three alternatives have the same rank in terms of implementability.

5.3 Cost

The present-worth costs of each of the alternatives are summarized in **Table 5-3**. The detailed cost breakdown for each alternative is provided in **Appendix A**. As shown in **Table 5-3**, Alternative 4 is ranked best in terms of cost.

5.4 Overall Ranking of Alternatives

The overall ranking of the different alternatives in terms of their effectiveness, implementability, and cost is presented in **Table 5-4**. Alternative 4 has the best overall ranking and is recommended alternative.

Table 5-2 Implementability Criteria Evaluation

Alternative	Technical Feasibility	Admin Feasibility	Regulatory Acceptance	Community Acceptance	Overall Score	Rank
Alternative 1 No Action	NA	NA	NA	NA	NA	NA
Alternative 2 LUCs	1	1	3	3	8	**1**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	2	2	2	8	**1**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	3	3	1	1	8	**1**

Table 5-3 Cost Criteria Evaluation

Alternative	Total Project Duration (Years)	Capital Cost	Total O&M Cost	Total Present Cost of Alternative	Rank
Alternative 1 No Action	NA	NA	NA	NA	NA
Alternative 2 LUCs	30	$45,397	$335,879	381,276	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	30	$22,495	$432,441	454,936	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	$132,645	$0	132,645	**1**

Table 5-4 Alternatives Evaluation

Alternative	Effectiveness Rank	Implementability Rank	Cost Rank	Overall Score	Overall Rank
Alternative 1 No Action	NA	NA	NA	NA	NA
Alternative 2 LUCs	3	1	3	7	**3**
Alternative 3 Surface Removal of MEC/MPPEH Combined with LUCs	2	1	2	5	**2**
Alternative 4 Surface and Subsurface Removal of MEC/MPPEH	1	1	1	3	**1**

6.0 RECOMMENDATIONS

This EE/CA presents the selected RA alternative for the MEC/MPPEH hazards at the FI857a MRS at Holloman AFB in Otero County, New Mexico, developed in accordance with CERCLA as amended and consistent with the NCP. This decision is based on the information gathered during the previous investigations completed at the site and included in the Administrative Record for the site. The action recommended for this site is Alternative 4 – Surface and Subsurface Removal of MEC/MPPEH, which will achieve the RAO with a higher certainty of success and is consistent with what is anticipated to be overall final remedy for the site. This alternative addresses the explosive safety issues associated with MEC/MPPEH, while the other alternatives leave them in place by varying degrees with no means to mitigate the hazard. Additionally, Alternative 4 provides the greatest protection of human health and the environment and long term effectiveness while being less expensive to implement than the other alternatives. Implementation of this alternative will permit site closeout which means that no restrictions on future land use are needed for this site and no further restoration funds are required to be expended at FI857a MRS. Conditions at the site meet the USEPA 40 CFR § 300.415(b)(2)(vi) - threat of fire or explosion - criterion for initiating an RA. The total project cost, if approved, is estimated to be $132,645 with no PRSC costs.

6.1 Public Participation

Following completion of the EE/CA, community relations and administrative record activities necessary for all RAs will be performed.

According to Section 300.415(m) of the NCP, the Lead Agency (USAF) will conduct the following community relations activities:

- Designate a community relations spokesperson,
- Establish the information repository,
- Conduct community interviews,
- Prepare Community Relations Plan, and
- Issue public notice in the Alamogordo Daily News of availability of the EE/CA.

According to Section 300.820 of the NCP, the Lead Agency will conduct the following administrative record requirements:

- Establish the administrative record file,
- Publish public notice of the availability of the administrative record file,
- Hold a public comment period,
- Develop written responses to significant public comments, and
- Complete the administrative record file after selecting the response.

Written responses to significant comments will be summarized in an Action Memorandum and will be included in the Administrative Record.

6.2 Removal Action Schedule

The general completion time frames for activities associated with the NTCRA at the FI857a MRS are summarized in **Table 6-1**.

Table 6-1 Removal Action Schedule

EE/CA (preparation, review, and approval)	15 November 2013 to 25 November 2014
Action Memorandum (with public comment period)	26 November 2014 to 4 June 2015
Explosives Safety Submission	1 October 2013 to 8 July 2014
NTCRA WP (preparation, review, and approval)	19 February 2015 to 9 November 2015
Fieldwork	10 November 2015 to 30 November 2015
After Action Report	1 December 2015 to 15 September 2016
Site Closeout	16 September 2016 to 27 July 2017

7.0 REFERENCES

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USACE. 2009d. DID Number MMRP-09-005: Accident Prevention Plan. 19 August.

USACE. 2009e. DID Number MMRP-09-010: EE/CA, RI, and FS Reports. 19 August.

USACE. 2009f. DID Number MMRP-09-011: Accident/Incident Reports. 19 August.

USACE. 2009g. DID Number MMRP-09-012: Personnel Qualifications Certification Letter. 19 August.

Appendix A
Removal Action Alternatives Cost Estimates

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Alternative 1
No Action

This page is intentionally left blank.

There is no cost associated with Alternative 1.

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Alternative 2
Land Use Controls

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

This report for official U.S. Government use only.

Phase Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator

This report for official U.S. Government use only.

Phase Cost Detail Report
(with Markups)

Agency/Org./Office: FPM
Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

This report for official U.S. Government use only.

Phase Cost Detail Report
(with Markups)

Phase:

Phase Type: Operations & Maintenance
Phase Name: Fencing and LUC/ICs-Alt2
Description:

Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0

This report for official U.S. Government use only.

Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
ADMINISTRATIVE LAND USE CONTROLS	$147,518							$97,857	$245,375
(100% Prime)		$0	$0	$70,942	$10,831	$0	$16,084		
MEC Institutional Controls	$30,913							$14,484	$45,397
(100% Prime)		$0	$0	$7,200	$2,931	$0	$4,353		
Total Phase Cost	$178,431	$0	$0	$78,142	$13,762	$0	$20,437	$112,341	$290,772
						Escalation			$90,504
						Escalated Phase Cost			$381,276

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Phase Cost Detail Report
(with Markups)

Markup Template

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator
Agency/Org./Office: FPM

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Operations & Maintenance
Phase Name: Fencing and LUC/ICs-Alt2
Description:

Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0

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Phase Technology Cost Detail Report
(with Markups)

Technology: ADMINISTRATIVE LAND USE CONTROLS

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040934	UXO Technician II	4.00	HR	0.00	51.46	0.00	0.00	$205.84	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	800.00	$2,400.00	☑	☐
33220102	Project Manager	2.00	HR	0.00	193.20	0.00	0.00	$386.39	☐	☑
33220106	Staff Engineer	16.00	HR	0.00	186.89	0.00	0.00	$2,990.24	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220112	Field Technician	4.00	HR	0.00	115.90	0.00	0.00	$463.60	☐	☑
33220114	Word Processing/Clerical	2.00	HR	0.00	81.71	0.00	0.00	$163.42	☐	☑
33220115	Draftsman/CADD	2.00	HR	0.00	89.68	0.00	0.00	$179.36	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	355.57	0.00	0.00	0.00	$355.57	☑	☑

Total Element Cost	**$8,179.18**
Total 1st Year Technology Cost	**$8,179.18**

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Phase Technology Cost Detail Report (with Markups)

Technology: MEC Institutional Controls

Element: Implementation

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	12.00	DAY	0.00	0.00	0.00	63.64	$763.69	☐	☑
33010202	Per Diem (per person)	12.00	DAY	0.00	0.00	0.00	123.00	$1,476.00	☑	☐
33040927	UXO Senior Scientist	98.00	HR	0.00	120.59	0.00	0.00	$11,817.38	☐	☑
33240101	Other Direct Costs	1.00	LS	118.17	0.00	0.00	0.00	$118.17	☑	☑

Total Element Cost **$14,175.25**

Element: Engineering Controls

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
18040105	Boundary Fence, 5' Galvanized	919.00	LF	17.54	12.58	2.74	0.00	$30,201.89	☐	☑
18040501	Hazardous Waste Signing	10.00	EA	63.89	38.07	0.00	0.00	$1,019.63	☐	☑

Total Element Cost **$31,221.52**

Total 1st Year Technology Cost **$45,396.77**

Total Phase Cost **$53,575.95**

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Alternative 3
Surface Removal of MEC/MPPEH Combined with LUCs

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator

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Phase Cost Detail Report
(with Markups)

Agency/Org./Office: FPM
Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

This report for official U.S. Government use only.

Phase Cost Detail Report
(with Markups)

Phase:

Phase Type: Remedial Action
Phase Name: Surface Clearance- Alt 3
Description:

Approach: Ex Situ
Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Site Characterization & Removal Assessment	Yes	100	0
2015 SURFACE SWEEP	Yes	100	0
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0
2020 SURFACE SWEEP	Yes	100	0
2025 SURFACE SWEEP	Yes	100	0
2030 SURFACE SWEEP	Yes	100	0
2035 SURFACE SWEEP	Yes	100	0
2040 SURFACE SWEEP	Yes	100	0
2045 SURFACE SWEEP	Yes	100	0

This report for official U.S. Government use only.

Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
MEC Site Characterization & Removal Assessment	$12,153							$3,448	$15,601
(100% Prime)		$0	$0	$1,644	$726	$0	$1,078		
2015 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
ADMINISTRATIVE LAND USE CONTROLS	$147,518							$97,857	$245,375
(100% Prime)		$0	$0	$70,942	$10,831	$0	$16,084		
MEC Institutional Controls	$4,859							$2,035	$6,894
(100% Prime)		$0	$0	$995	$419	$0	$622		
2020 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2025 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2030 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2035 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		

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Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
2040 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
2045 SURFACE SWEEP	$5,321							$4,723	$10,044
(100% Prime)		$0	$0	$3,368	$546	$0	$810		
Total Phase Cost	$201,773	$0	$0	$97,157	$15,795	$0	$23,456	$136,408	$338,181
						Escalation			$116,758
						Escalated Phase Cost			$454,936

This report for official U.S. Government use only.

Phase Cost Detail Report
(with Markups)

Markup Template

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator
Agency/Org./Office: FPM

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Remedial Action
Phase Name: Surface Clearance- Alt 3
Description:

Approach: Ex Situ
Start Date: October, 2014
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Site Characterization & Removal Assessment	Yes	100	0
2015 SURFACE SWEEP	Yes	100	0
ADMINISTRATIVE LAND USE CONTROLS	Yes	100	0
MEC Institutional Controls	Yes	100	0
2020 SURFACE SWEEP	Yes	100	0
2025 SURFACE SWEEP	Yes	100	0
2030 SURFACE SWEEP	Yes	100	0
2035 SURFACE SWEEP	Yes	100	0
2040 SURFACE SWEEP	Yes	100	0
2045 SURFACE SWEEP	Yes	100	0

This report for official U.S. Government use only.

Phase Technology Cost Detail Report (with Markups)

Technology: MEC Site Characterization & Removal Assessment

Element: Site Characterization

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	14.00	DAY	0.00	0.00	0.00	123.00	$1,722.00	☑	☐
33021530	Differential GPS Unit Rental	1.00	MO	95.35	0.00	0.00	0.00	$95.35	☐	☑
33040223	Ordnance Locator, Schoenstedt, Model GA-72CD, weekly rental	7.00	WK	0.00	0.00	0.00	146.10	$1,022.68	☐	☑
33040651	4 X 4 Truck- Rental/Lease	11.00	DAY	0.00	0.00	110.31	0.00	$1,213.46	☐	☑
33040921	Senior UXO Supervisor (SUXOS)	10.00	HR	0.00	77.16	0.00	0.00	$771.60	☐	☑
33040923	UXO Project Manager	10.00	HR	0.00	100.91	0.00	0.00	$1,009.10	☐	☑
33040930	UXO QC Specialist	10.00	HR	0.00	71.05	0.00	0.00	$710.52	☐	☑
33040931	UXO Safety Officer	10.00	HR	0.00	70.21	0.00	0.00	$702.13	☐	☑
33040934	UXO Technician II	60.00	HR	0.00	51.46	0.00	0.00	$3,087.59	☐	☑
33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	61.74	0.00	0.00	$617.44	☐	☑
33041001	16oz Standard TNT Booster	10.00	EA	0.56	0.00	0.00	0.00	$5.57	☐	☑
33041002	50 gr/ft Det -Cord (1000 ft roll)	2.00	EA	794.36	0.00	0.00	0.00	$1,588.72	☐	☑
33041004	12 ft Lead Primadet Non-Electric Detonators	5.00	EA	9.53	0.00	0.00	0.00	$47.66	☐	☑
33041101	Airfare	4.00	LS	0.00	0.00	0.00	750.00	$3,000.00	☑	☐
33240101	Other Direct Costs	1.00	LS	7.49	0.00	0.00	0.00	$7.49	☑	☑

Total Element Cost	**$15,601.33**
Total 1st Year Technology Cost	**$15,601.33**

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Technology: 2015 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

This report for official U.S. Government use only.

Phase Technology Cost Detail Report
(with Markups)

Technology: ADMINISTRATIVE LAND USE CONTROLS

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040934	UXO Technician II	4.00	HR	0.00	51.46	0.00	0.00	$205.84	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	800.00	$2,400.00	☑	☐
33220102	Project Manager	2.00	HR	0.00	193.20	0.00	0.00	$386.39	☐	☑
33220106	Staff Engineer	16.00	HR	0.00	186.89	0.00	0.00	$2,990.24	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220112	Field Technician	4.00	HR	0.00	115.90	0.00	0.00	$463.60	☐	☑
33220114	Word Processing/Clerical	2.00	HR	0.00	81.71	0.00	0.00	$163.42	☐	☑
33220115	Draftsman/CADD	2.00	HR	0.00	89.68	0.00	0.00	$179.36	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	355.57	0.00	0.00	0.00	$355.57	☑	☑

Total Element Cost	**$8,179.18**
Total 1st Year Technology Cost	**$8,179.18**

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Phase Technology Cost Detail Report
(with Markups)

Technology: MEC Institutional Controls

Element: Implementation

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	5.00	DAY	0.00	0.00	0.00	63.64	$318.20	☐	☑
33010202	Per Diem (per person)	5.00	DAY	0.00	0.00	0.00	123.00	$615.00	☑	☐
33040927	UXO Senior Scientist	40.00	HR	0.00	120.59	0.00	0.00	$4,823.42	☐	☑
33240101	Other Direct Costs	1.00	LS	118.17	0.00	0.00	0.00	$118.17	☑	☑

Total Element Cost **$5,874.80**

Element: Engineering Controls

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
18040501	Hazardous Waste Signing	10.00	EA	63.89	38.07	0.00	0.00	$1,019.63	☐	☑

Total Element Cost **$1,019.63**

Total 1st Year Technology Cost **$6,894.43**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2020 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2025 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2030 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2035 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2040 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**

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Phase Technology Cost Detail Report
(with Markups)

Technology: 2045 SURFACE SWEEP

Element: Monitoring & Enforcement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010108	Sedan, Automobile, Rental	1.00	DAY	0.00	0.00	0.00	63.64	$63.64	☐	☑
33010202	Per Diem (per person)	3.00	DAY	0.00	0.00	0.00	123.00	$369.00	☑	☐
33040925	UXO Staff Engineer	8.00	HR	0.00	84.48	0.00	0.00	$675.87	☐	☑
33040926	UXO Junior Engineer	8.00	HR	0.00	51.03	0.00	0.00	$408.24	☐	☑
33041101	Airfare	3.00	LS	0.00	0.00	0.00	500.00	$1,500.00	☑	☐
33220102	Project Manager	4.00	HR	0.00	193.20	0.00	0.00	$772.79	☐	☑
33220106	Staff Engineer	24.00	HR	0.00	186.89	0.00	0.00	$4,485.36	☐	☑
33220110	QA/QC Officer	2.00	HR	0.00	158.97	0.00	0.00	$317.93	☐	☑
33220114	Word Processing/Clerical	4.00	HR	0.00	81.71	0.00	0.00	$326.84	☐	☑
33220115	Draftsman/CADD	4.00	HR	0.00	89.68	0.00	0.00	$358.71	☐	☑
33220119	Health and Safety Officer	2.00	HR	0.00	142.09	0.00	0.00	$284.19	☐	☑
33240101	Other Direct Costs	1.00	LS	481.66	0.00	0.00	0.00	$481.66	☑	☑

Total Element Cost	**$10,044.23**
Total 1st Year Technology Cost	**$10,044.23**
Total Phase Cost	**$100,984.55**

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Alternative 4
Surface and Subsurface Removal of MEC/MPPEH

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Phase Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator

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Phase Cost Detail Report
(with Markups)

Agency/Org./Office: FPM
Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

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Phase Cost Detail Report
(with Markups)

Phase:

Phase Type: Study
Phase Name: Surface and Subsurface Clearance - Alt4
Description:

Start Date: December, 2015
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Removal Action	Yes	100	0

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Phase Cost Detail Report
(with Markups)

Technology	Direct Cost	Sub Overhead	Sub Profit	Prime Overhead	Prime Profit	Contingency	Owner Cost	Markup Total	Total
MEC Removal Action (100% Prime)	$88,043	$0	$0	$16,825	$6,910	$0	$10,261	$33,997	$122,040
Total Phase Cost	$88,043	$0	$0	$16,825	$6,910	$0	$10,261	$33,997	$122,040
						Escalation			$10,605
						Escalated Phase Cost			$132,645

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Phase Cost Detail Report
(with Markups)

Markup Template

System Defaults	Markup Percentage
Professional Labor Overhead/G&A	132.0
Field Office Overhead/G&A	25.0
Subcontractor Profit	8.0
Prime Profit	8.0
Contingency	0.0
Owner Cost	11.0

Comment:

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Phase Technology Cost Detail Report
(with Markups)

System:

RACER Version: 10.4.0
Database Location: C:\Users\daniel.FPM-GROUP\Application Data\AECOM\RACER 10.4\Racer.mdb

Folder:

Folder Name: NM-AZ Group-EE/CAs

Project:

Project ID: Holloman AFB
Project Name: Holloman AFB
Project Category: None

Location
State / Country: NEW MEXICO
City: HOLLOMAN AFB

Location Modifier	Default	User
	1.093	1.093

Options
Database: System Costs
Cost Database Date: 2011
Report Option: Fiscal

Description

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Phase Technology Cost Detail Report
(with Markups)

Site:

Site ID: FI857a
Site Name: FI857a
Site Type: None

Media/Waste Type

Primary: Soil
Secondary: N/A

Contaminant

Primary: Ordnance (not residual)
Secondary: None

Phase Names

Pre-Study: ☐
Study: ☑
Design: ☐
Removal/Interim Action: ☑
Remedial Action: ☑
Operations & Maintenance: ☑
Long Term Monitoring: ☑
Site Closeout: ☑

Documentation

Description:
Support Team: Documentation of personnel used to provide support for estimator and preparation of the estimate.
References: Documentation of reference sources usn the preparation of the estimate.

Estimator Information

Estimator Name: Daniel Baldyga
Estimator Title: FPM Estimator
Agency/Org./Office: FPM

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Phase Technology Cost Detail Report
(with Markups)

Business Address: FPM
Rome, New York 13441
Telephone Number: 315-336-7721
Email Address: d.baldyga@fpm-remediations.com
Estimate Prepared Date: 04/12/2013

Estimator Signature: _____ **Date:** _____

Reviewer Information

Reviewer Name:
Reviewer Title:
Agency/Org./Office:
Business Address:
Telephone Number:
Email Address:
Date Reviewed:

Reviewer Signature: _____ **Date:** _____

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Phase Technology Cost Detail Report
(with Markups)

Phase:

Phase Type: Study
Phase Name: Surface and Subsurface Clearance - Alt4
Description:

Start Date: December, 2015
Labor Rate Group: System Labor Rate
Analysis Rate Group: System Analysis Rate

Phase Markups: System Defaults

Technology Markups	Markup	% Prime	% Sub.
MEC Removal Action	Yes	100	0

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Phase Technology Cost Detail Report (with Markups)

Technology: MEC Removal Action

Element: Vegetation Removal

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
17010401	Chipping brush, light brush	1.00	ACR	0.00	1,391.69	537.06	0.00	$1,928.75	☐	☑
33010202	Per Diem (per person)	1.00	DAY	0.00	0.00	0.00	123.00	$123.00	☑	☐
33040935	UXO Technician III (UXO Supervisor)	10.00	HR	0.00	61.74	0.00	0.00	$617.44	☐	☑

Total Element Cost **$2,669.19**

Element: UXO Mapping

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	13.00	DAY	0.00	0.00	0.00	123.00	$1,599.00	☑	☐
33021530	Differential GPS Unit Rental	2.00	MO	95.35	0.00	0.00	0.00	$190.70	☐	☑
33040210	Geonics EM-61 Metal Locator, Towed (Weekly Rental)	1.00	WK	0.00	0.00	0.00	602.73	$602.73	☐	☑
33040223	Ordnance Locator, Schoenstedt, Model GA-72CD, weekly rental	7.00	WK	0.00	0.00	0.00	146.10	$1,022.68	☐	☑
33040230	Geonics EM-61 Metal Locator, Hand Held (Weekly Rental)	1.00	WK	0.00	0.00	0.00	485.20	$485.20	☐	☑
33040651	4 X 4 Truck- Rental/Lease	6.00	DAY	0.00	0.00	110.31	0.00	$661.89	☐	☑
33040653	All Terrain Vehicle (ATV) - Rental/Lease	1.00	DAY	299.18	0.00	0.00	0.00	$299.18	☐	☑
33040934	UXO Technician II	60.00	HR	0.00	51.46	0.00	0.00	$3,087.59	☐	☑
33040935	UXO Technician III (UXO Supervisor)	20.00	HR	0.00	61.74	0.00	0.00	$1,234.88	☐	☑

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Phase Technology Cost Detail Report (with Markups)

Element: UXO Mapping

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33040936	Geophysicist (UXO)	20.00	HR	0.00	77.71	0.00	0.00	$1,554.14	☐	☑
33041101	Airfare	10.00	LS	750.00	0.00	0.00	0.00	$7,500.00	☑	☐
33240101	Other Direct Costs	1.00	LS	1,045.27	0.00	0.00	0.00	$1,045.27	☑	☑
					Total Element Cost			**$19,283.26**		

Element: UXO Removal

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	23.00	DAY	0.00	0.00	0.00	123.00	$2,829.00	☑	☐
33040223	Ordnance Locator, Schoenstedt, Model GA-72CD, weekly rental	4.00	WK	0.00	0.00	0.00	146.10	$584.39	☐	☑
33040646	Backhoe - Rental/Lease	4.00	DAY	0.00	0.00	332.41	0.00	$1,329.63	☐	☑
33040651	4 X 4 Truck- Rental/Lease	7.00	DAY	0.00	0.00	110.31	0.00	$772.20	☐	☑
33040934	UXO Technician II	120.00	HR	0.00	51.46	0.00	0.00	$6,175.18	☐	☑
33040935	UXO Technician III (UXO Supervisor)	20.00	HR	0.00	61.74	0.00	0.00	$1,234.88	☐	☑
33041001	16oz Standard TNT Booster	4.00	EA	0.56	0.00	0.00	0.00	$2.23	☐	☑
33041002	50 gr/ft Det -Cord (1000 ft roll)	1.00	EA	794.36	0.00	0.00	0.00	$794.36	☐	☑
33041004	12 ft Lead Primadet Non-Electric Detonators	2.00	EA	9.53	0.00	0.00	0.00	$19.06	☐	☑
33240101	Other Direct Costs	1.00	LS	552.90	0.00	0.00	0.00	$552.90	☑	☑
					Total Element Cost			**$14,293.83**		

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Phase Technology Cost Detail Report (with Markups)

Element: Site Management

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33010202	Per Diem (per person)	28.00	DAY	0.00	0.00	0.00	123.00	$3,444.00	☑	☐
33040651	4 X 4 Truck- Rental/Lease	28.00	DAY	0.00	0.00	110.31	0.00	$3,088.81	☐	☑
33040921	Senior UXO Supervisor (SUXOS)	40.00	HR	0.00	77.16	0.00	0.00	$3,086.42	☐	☑
33040923	UXO Project Manager	40.00	HR	0.00	100.91	0.00	0.00	$4,036.39	☐	☑
33040930	UXO QC Specialist	40.00	HR	0.00	71.05	0.00	0.00	$2,842.10	☐	☑
33040931	UXO Safety Officer	40.00	HR	0.00	70.21	0.00	0.00	$2,808.53	☐	☑
33041101	Airfare	4.00	LS	750.00	0.00	0.00	0.00	$3,000.00	☑	☐
				Total Element Cost				**$22,306.24**		

Element: Stakeholder Involvement

Assembly	Description	Quantity	Unit of Measure	Material Unit Cost	Labor Unit Cost	Equipment Unit Cost	Sub Bid Unit Cost	Extended Cost	Cost Override	Markups Applied
33040923	UXO Project Manager	12.00	HR	0.00	100.91	0.00	0.00	$1,210.92	☐	☑
33040935	UXO Technician III (UXO Supervisor)	12.00	HR	0.00	61.74	0.00	0.00	$740.93	☐	☑
33041302	Site Specific Workplan (Moderate Complexity)	1.00	EA	155.60	22,597.37	0.00	0.00	$22,752.96	☐	☑
33041305	Explosive Safety Submission (Moderate Complexity)	1.00	EA	311.19	10,491.28	0.00	0.00	$10,802.48	☐	☑
33041314	UXO Removal Report (Moderate Complexity)	1.00	EA	311.19	27,668.51	0.00	0.00	$27,979.70	☐	☑
				Total Element Cost				**$63,486.99**		
				Total 1st Year Technology Cost				**$122,039.51**		

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Phase Technology Cost Detail Report
(with Markups)

Total Phase Cost	**$122,039.51**

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