FINAL

REMEDIAL INVESTIGATION REPORT

For:

MUNITIONS RESPONSE SITE
FORMER MAKANALUA BOMBING RANGE
FUDS PROJECT NO. H09HI020301

ISLAND OF MOLOKAI, HAWAII
Contract No. W912PP-11-C-0035

prepared for

U.S. Army Engineer District, Sacramento
U.S. Army Engineer District, Honolulu

Prepared by

Malama Aina JV, LLC

FINAL
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ACRONYMS AND ABBREVIATIONS

AP	Armor Piercing
asl	Above Sea Level
bgs	Beneath Ground Surface
ARAR	Applicable or Relevant and Appropriate Requirement
BSI	Blind Seed Item
CEPOH	United States Army Corps of Engineers, Honolulu District
CESPK	United States Army Corps of Engineers, Sacramento District
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
COC	Chain of Custody
COPC	Chemicals of Potential Concern
CSM	Conceptual Site Model
CWM	Chemical Warfare Materiel
DD	Decision Document
DERP	Defense Environmental Restoration Program
DFW	Definable Feature of Work
DGPS	Differential Global Positioning System
DID	Data Item Description
DLNR	Department of Land and Natural Resources
DMM	Discarded Military Munitions
DoD	Department of Defense
DQO	Data Quality Objective
DU	Decision Unit
E2	Element Environmental
EHE	Explosive Hazard Evaluation
EM	Engineering Manual
EP	Engineering Pamphlet
EPA	Environmental Protection Agency
EOD	Explosive Ordnance Disposal
ESCQ	Explosive Safety Quantity Distance
FFID	Federal Facility Identifier
FFP	Firm Fixed Price
FS	Feasibility Study
FUDS	Formerly Used Defense Sites

FUDSMIS	Formerly Used Defense Sites Management Information System
FUP	Fixed Unit Price
GANDA	Garcia and Associates
GIS	Geographical Information System
GP	General Purpose
HA	Hazard Assessment
HAR	State of Hawaii Administrative Rules
HDOH	Hawaii Department of Health
HE	High Explosive
HFD	Hazardous Fragment Distance
HHE	Health Hazard Evaluation
INPR	Inventory Project Report
IS	Incremental Sampling
ITS	Instrument Test Strip
LCS	Laboratory Control Spike
LDC	Laboratory Data Consultants
LOD	Limit of Detection
MAJV	Malama Aina Joint Venture LLC
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MDEH	Material Documented as an Explosive Hazard
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MD	Munitions Debris
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
MS	matrix spike
MSD	matrix spike duplicate
NCP	National Contingency Plan
ND	Non-detect
NDAI	No Department of Defense Action Indicated
NFA	No Further Action
NHV	Native Hawaiian Veterans, LLC
NOAA	National Oceanic and Atmospheric Administration

NPS	National Park Service
NRS	Natural Resource Support
OSHA	Occupational Safety and Health Administration
PDA	Personal Digital Assistant
PDT	Project Delivery Team
PIP	Public Involvement Plan
PM	Project Manager
PMP	Project Management Plan
PWS	Performance Work Statement
QA	Quality Assurance
QAP	Quality Assurance Program
QC	Quality Control
QCP	Quality Control Plan
RAC	Risk Assessment Code
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RL	Reporting Limit
ROD	Record of Decision
ROV	Remotely Operated Vehicle
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SDTS	Spatial Data Transfer Standard
SI	Site Inspection
SOP	Standard Operating Procedure
TBC	To Be Considered
T&E	Threatened and Endangered Species
T&S	Threatened and Endangered Species
TCL	Target Compound List
TES	Timberline Environmental Services
TPP	Technical Project Planning
TTU	Thermal Treatment Unit
USACE	United States Army Corps of Engineers
USC	United States Code
US	United States
USDA	United States Department of Agriculture
UXO	Unexploded Ordnance

UXOQCS	UXO Quality Control Specialist
UXOSO	UXO Safety Officer
VSP	Visual Sample Planning
WS	Work Sheet
WP	Work Plan

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EXECUTIVE SUMMARY

ES.1 INTRODUCTION

This report describes the results of a Remedial Investigation (RI) conducted from February 2013 to April 2013 at the former Makanalua Bombing Range (MBR) site located at Kalaupapa, Molokai, Hawaii, by Malama Aina Joint Venture (MAJV). Acquired by the Navy by permit in 1941 and used for bombing training until October 1946, the site is comprised of 937 acres (832 land acres and 105 tidal water acres) to include bombing range and rocket range buffers. (Note: the preceding acreages represent what is reported in Formerly Used Defense Sites Management Information System (FUDSMIS), the site acreage calculated with Geographic Information System (GIS) software is 713.25 acres [552.95 land acres (including the 2.22 acres Heiau) and 160.30 water acres]. The acreages reported in the document and on maps use the GIS acreage for this report. In 2008, the USACE conducted a land-based Site Inspection (SI) of the former MBR confirming the historical findings and recommending that an RI should be conducted within the Range Complex No. 1 MRS. This report is the result of the land-based RI conducted during February 2013 to April 2013.

This RI report is prepared as a standalone document. The recommended feasibility study (FS) report will be prepared separately.

ES.2 REMEDIAL INVESTIGATION ACTIVITIES AND RESULTS

From February 25 to April 17, 2013, RI field activities were conducted at the former MBR. Field activities included vegetation removal, 100% transect anomaly investigation (surface and subsurface), and MC sampling.

For Munitions and Explosives of Concern (MEC), 100% anomaly investigation of transects with 100% coverage of the land portion of site was conducted. As agreed by the Technical Project Planning (TPP) Team, the water portions of the site were not investigated due to the dangerous sea conditions caused by a rocky shoreline, constant high waves and strong tidal currents. Incremental Sampling was conducted at five Decision Units (DUs) and soil samples analyzed for MC metals and explosives. The amount and quality of data is considered sufficient to characterize the site.

ES.3 SUMMARY OF TRANSECT INVESTIGATION

The MBR transect miles completed were 17.14 miles, equaling 8.31 total acres. Transect spacing and locations established in Visual Sampling Planning software, were 4-ft wide and investigated to depth of detection using a handheld metal detector (Minelab Explorer II). All transects were 100% investigated on the surface and in the subsurface for all anomalies identified. Quality Control (QC) was conducted on 100 percent of transects as well.

The investigation of the anomalies within transects resulted in the discovery of 99 MEC items (in the form of UXO) and 1,024 lbs of MD. UXO items found on the surface and to a depth of 18 inches during the RI included: 3 lb Practice Bombs, (AN-Mk 5; and AN-Mk 23); 4.5 lb Practice Bomb, AN-Mk 43; and 13 lb Practice Bomb, AN-Mk 19. A total of 1,024 lbs of MD were removed from the site from the surface and to a depth of 24 inches. The data collected correlates with prior investigations findings and no unexpected munitions were encountered.

ES.4 SUMMARY OF MC SAMPLING

For evaluation of the presence of MC, incremental soil (IS) sampling was conducted in five DUs. Three within the high UXO/MD density area; and two within the area of the site where only very low densities of expended small arms ammunition were found and collected from soil where no MD was found (for MC metals background comparison values). No other media (groundwater, surface water, sediment, or air) were sampled at the site during the current investigation. Groundwater beneath the site is not potable. No surface water other than the Pacific Ocean is present onsite. MC metals (lead, copper, antimony, and zinc) and explosive compounds were analyzed. No explosives were detected. Lead, copper, antimony, and zinc were detected in samples collected within the target area, but did not exceed HDOH Tier 1 Environmental Action Levels (EALs). ***There is no evidence explosives are present in the soil; and exposure to MC metals (antimony, copper, lead, and zinc) present in surface soils at the former MBR site does not pose an unacceptable risk to human or ecological health.***

ES.5 MRSPP SCORING

Draft Munitions Response Site Prioritization Protocol (MRSPP) scoring tables were completed for both the Target Area (high MEC/MD density target area) and the area where only very low densities of expended small arms ammunition were found in the Remaining Lands of Range Complex No. 1 MRS. Copies of the MRSPP Scoring Tables are appended to this RI Report. The Range Complex No. 1-Target Area was evaluated with a MRSPP Rating of "5". MRS priorities range from 1 (highest priority) to 8 (lowest priority). A score of 1 can only be assigned to a site with known Chemical Warfare Materials present onsite.

Range Complex No. 1-Remaining Lands was evaluated as "*No Known or Suspected Hazard*".

ES.6 MUNITIONS AND EXPLOSIVES OF CONCERN HAZARD ASSESSMENT (MEC HA) SCORING

Potential explosive hazards from UXO at the site were evaluated using the United States Environmental Protection Agency's (EPA) MEC Hazard Assessment (HA) methodology (EPA 2008). The results of the MEC HA baseline analysis for the target area of Range Complex No. 1 MRS are evaluated to be Hazard Level Category 2, based on a MEC HA score of 795.

ES.7 RECOMMENDATIONS

The Range Complex No. 1 MRS is recommended to be re-delineated into two areas as summarized in Table ES-1 and shown in Figure ES.1. The new boundaries are recommended based on level of potential explosive hazard present in each area determined by UXO/MD findings encountered during historical site visits and the 2013 RI. Separating the MRS area into two allows each area to be addressed in a cost-efficient and sensible manner appropriate to the explosive hazard present within each area.

ES.7.1 Range Complex No. 1 – Target Area (232.84 acres)

The **Target Area** (230.08 acres, land within the current FUDS Property boundary, including the 2.22 ac Heiau) is recommended to proceed to the next step in the CERCLA process, evaluation of remedial alternatives through a feasibility study (FS) for a remediation action of MEC (explosive hazard from UXO present onsite).

This re-delineation of the Target Area extends 2.76 acres outside the currently defined FUDS boundary. The extension of the target area outside the FUDS boundary is recommended due to the close proximity of MD items found near the site boundary. It is recommended the newly included acreage be processed for inclusion in the FUDS boundary. The inclusion of this area would bring the total Target Area to 232.84 acres, and the total MRS acreage to 716.01 acres.

A classification of No Department of Defense (DoD) Action Indicated (NDAI) is recommended for MC in Range Complex No. 1-Target Area. No suspected unacceptable risk to human or ecological receptors from MC is present.

ES.7.2 Range Complex No. 1 - Remaining Lands (483.17 acres)

The **Remaining Lands** (483.17 acres: 322.87 land and 160.30 tidal water) is recommended to proceed to a NDAI determination for both MEC and MC based on finding no evidence of unacceptable hazards from MEC or risks from MC due to impacts from DoD activity.

The entire tidal water portion of the site is included in the Remaining Lands. Based on the MEC investigation of the land and the location of the target area, and the fact the dangerous sea conditions would not attract recreational boaters or divers, no further investigation of the tidal water areas is recommended.

Table ES-1: Recommendation Summary

MRS	Acreage	Recommendation	Basis for Recommendation MEC/MD/MC	MRSPP Priority
Range Complex No. 1 -**Target Area**	232.84[(1)] (land)	MEC – FS	**MEC:** 99 UXO items in the form of practice bombs with signals found during the 2013 RI. **MD:** 1,024 lbs removed.	5
		MC – NDAI	**MC:** Concentrations of MC metals (antimony, copper, lead and zinc) below HDOH EALs. No detection of explosives. No surface water other than ocean located on site, Groundwater is not potable within the MRS. No unacceptable risk to human or ecological receptors is present from exposure to surface soils in this area.	No known or suspected hazards
Range Complex No. 1 - **Remaining Lands**	483.17 (322.87 land; 160.30 tidal water)	MEC – NDAI	**MEC:** No evidence of UXO, DMM, or explosive soils. **MD:** Only very low densities of expended small arms ammunition were observed.	No known or suspected hazards
		MC – NDAI	**MC:** Concentrations of MC metals (antimony, copper, lead and zinc) below HDOH EALs. No detection of explosives. No surface water other than ocean located on site, Groundwater is not potable within the MRS. No unacceptable risk to human or ecological receptors is present from exposure to surface soils in this area.	No known or suspected hazards

(1) The delineated target area recommended for FS includes the heiau and.2.76 acres outside the FUDS property boundary.

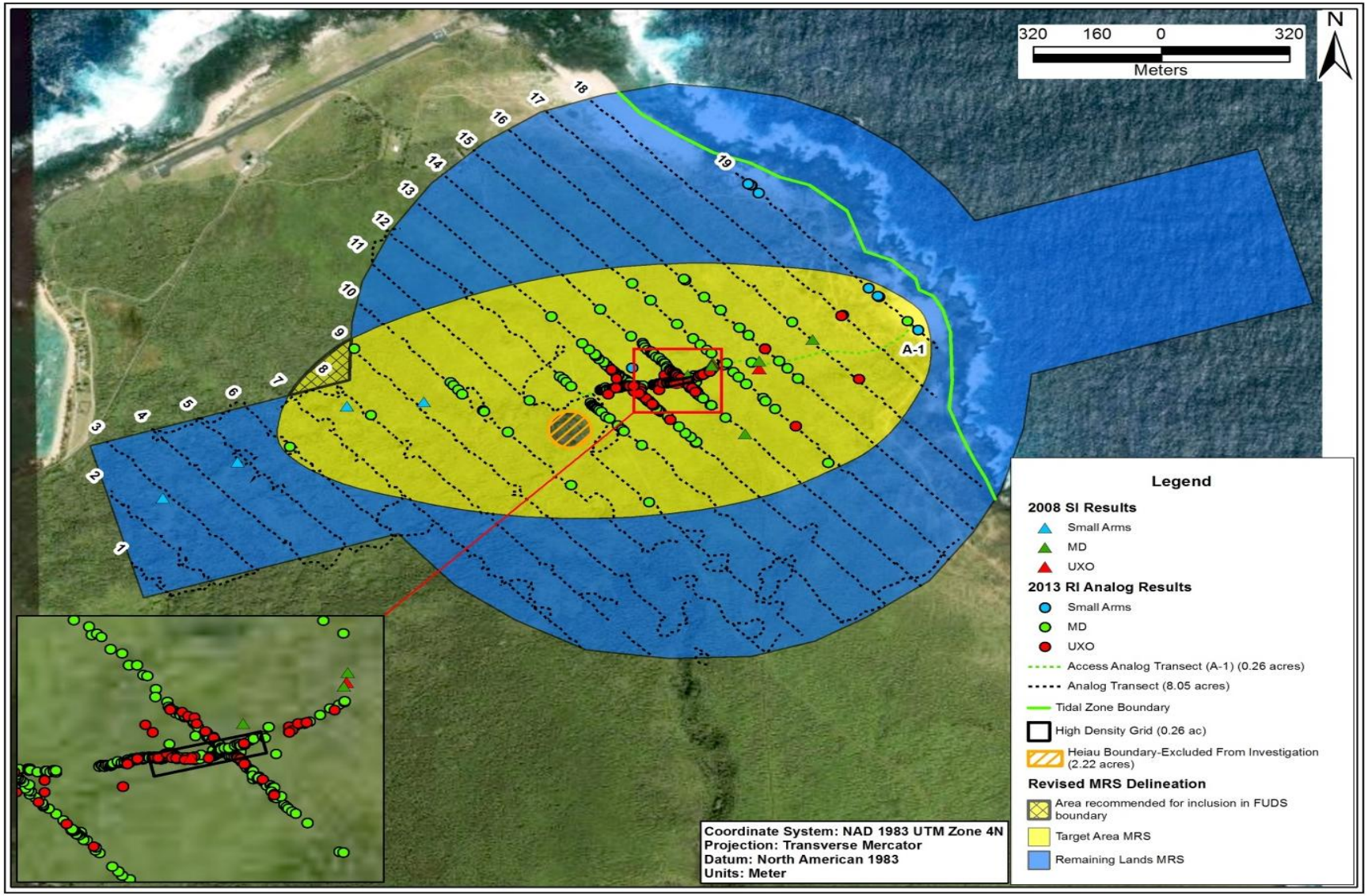

Figure ES.1 Proposed MRS Boundaries

CHAPTER 1. INTRODUCTION

This RI report was prepared for the United States Army Corps of Engineers Honolulu District (CEPOH) and the United States Army Corps of Engineers Sacramento District (CESPK) under Contract No. W912PP-11-C-0035. The work conducted during the RI followed the general procedures outlined in the Final RI Work Plan (WP) document dated January 2013 (Malama Aina JV, January 2013).

As agreed to by the TPP Team, this RI covers the land portion of the site only. The tidal water portions were not investigated due to dangerous sea conditions due to rocky shore line, constant large waves and strong current.

Deviations from procedures described in the RI WP document that arose due to conditions encountered in the field are described in the following sections. Malama Aina Joint Venture, LLC (MAJV) and their subcontractors adhering to the project-specific Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP) completed all scheduled fieldwork.

The United States (US) Congress has established the Military Munitions Response Program (MMRP) under the Defense Environmental Restoration Program (DERP) to address sites at which Munitions and Explosives of Concern (MEC) [which includes unexploded ordnance (UXO), discarded military munitions (DMM), and munitions constituents (MC)] that may present a potential hazard to human health or the environment. Sites determined to be eligible for the MMRP are hereafter referred to as Munitions Response Sites (MRSs).

The MBR project falls under the Defense Environmental Restoration Program/Formerly Used Defense Sites (DERP/FUDS) and is identified as FUDS Project No. H09HI020301. DERP was established by Congress in 1986 and directed by the Secretary of Defense to "…carry out a program of environmental restoration at facilities under the jurisdiction of the Secretary." Since the beginning of this program, the US Army Corps of Engineers (USACE) has been the agency responsible for environmental restoration of FUDS. The 1991 Inventory Project Report (INPR) established MBR as a FUDS, established the preliminary site boundary, and recommended an investigation to evaluate the presence of MEC. The 2004 INPR Supplement increased the acreage from 160 acres to 937 acres (832 land acres and 105 tidal water acres).

This project is conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 104, and the National Contingency Plan, Sections 300.120(d)-300.400(e).

All activities during the phases of field work were conducted in full compliance with USACE, Hawaii Department of Health (HDOH), and local requirements regarding personnel, equipment, and procedures. Standard Operating Procedures (SOPs) for the project's Definable Features of Work (DFW) were used as described in the RI Work Plan. The provisions of the Occupational Safety and Health Administration (OSHA) Standard 29 Code of Federal Regulations (CFR) 1910.120 and 29 CFR 1926.65 were applied to all MEC/Munitions Debris (MD)-related actions taken at this site.

1.1 PURPOSE

This RI is intended to characterize the former Makanalua Bombing Range (MBR) (i.e., determine the nature and extent of contamination from MEC and MC) for the purpose of developing and evaluating remedial alternatives for the land portion. The primary purpose of the RI report is to present the results from the RI and provide information to assess the extent to which a release poses a threat to human health, safety and the environment. If contamination is confirmed or identified, the information from the RI report will be used to support the Feasibility Study (FS) so a decision on a remedy can be made.

The results of this RI will be used for a recommendation to divide Range Complex No. 1 into separate areas based on explosive hazards, and if present, risks from munitions constituents (MC) if warranted.

1.2 PROPERTY DESCRIPTION

1.2.1 Topography

The former MBR is located on Kalaupapa Peninsula, Molokai, Hawaii (see Figure 1-1), which has an elevation that varies from approximately 25 ft above sea level (asl) to sea level. The terrain is generally flat or gently sloping to short steep gullies and rock formations.

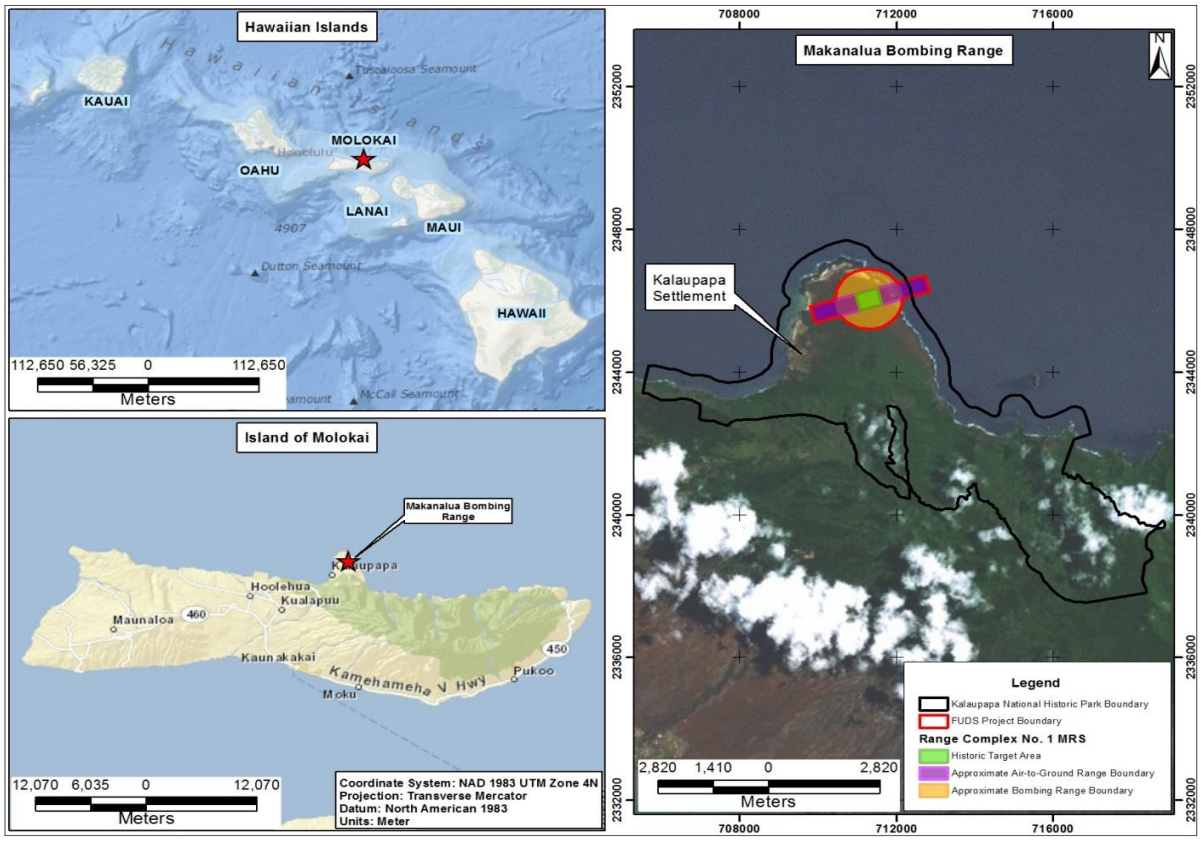

Figure 1-1: Project Location Map

1.2.2 Geology and Soils

The Island of Molokai was formed principally by extrusive shield and post-shield stage lavas of the older West Molokai Volcano and the younger East Molokai Volcano, and secondarily by rejuvenated stage volcanic rocks at Kalaupapa Peninsula. Kalaupapa Volcanics are comprised of the rejuvenated stage alkalic basalt and basanite that form the Kalaupapa Peninsula. Kalaupapa Volcanics is estimated to be between 350,000-500,000 years in age (USGS, 1997).

Kalaupapa basalt composes the primary geologic substrate of the gently sloping (one to three percent slopes) topography, which is interspersed with ʻaʻā and pāhoehoe lava. The inactive Kauhako volcanic vent is located in the southern portion of the study site. Kalaupapa's very rocky, silty clay loam is the major soil type throughout the remaining portions of the site, which is bordered to the south by rough mountainous land (CEPOH, 1991).

Only a thin veneer of soil (typically 3 in. thick or less) exists atop the lava flows and is composed of rocky, reddish-brown, silty clay.

1.2.3 Hydrology and Hydrogeology

The Island of Molokai is comprised of four hydrologic sectors. These four hydrologic sectors (West, Central, Northeast, and Southeast) are subdivided into sixteen aquifer systems. The MBR is underlain by the Kalaupapa aquifer system (40401) located in the Northeast sector. According to the system developed by Mink and Lau to classify and assign codes to the principal aquifers for the island of Molokai, the Kalaupapa Aquifer code is 40401111 (basal unconfined flank-aquifer type) and the status code is 21211 (potential use, drinking, low salinity, irreplaceable, with a vulnerability to contamination). The system is restricted to Kalaupapa Peninsula with a total area of 4.5 square miles. Basal groundwater saturates the basalt to several feet above sea level and the water is unpotable (Mink and Lau, 1992).

The 9-ft water level reported in a well at the northern margin of the dike complex near Kalaupapa Peninsula possibly represents an upper limit for the water-table height above sea level in the dike-free Kalaupapa Volcanics. Results from an electrical resistivity survey indicated that the basal lens in the Kalaupapa Volcanics was thin. The horizontal hydraulic conductivity value is calculated to be 500 ft/d per day.

There are no wells located within the MRS. There is one public water supply (municipal) well, three domestic water wells, and five other water wells within a 4-mile radius of the MRS. (Parsons, 2008).

The Pacific Ocean borders the northeast side of the Munitions Response Site (MRS). There is no perennial surface water or sediment present on site.

1.2.4 Climate

The temperatures at the MBR vary from approximately 73ºF in March to approximately 81ºF in September. There is a prevailing northeasterly trade wind throughout the year, and the term "windward" always refers to the direction of the trade winds, not the existing wind at any

particular time. Rainfall over the open sea near Molokai averages 25 to 30 in. per year. Mountains on the windward side of Molokai trigger rain showers from the trade winds. The site is located windward of the spectacular cliff, which reaches a maximum height of 3,600 ft, and forms the entire north coast of the mountain. Like all Hawaiian Islands, the windward side of Molokai receives much more rainfall than the leeward side of the island. The MBR region receives an average of 40 to 50 in. of rainfall annually (BTG, 2005).

1.2.5 Significant Structures

This site is currently uninhabited and undeveloped. No DoD related structures are within the MRS.

1.2.6 Cultural and Archaeological Resources

The MBR is located within the Kalaupapa National Historical Park, which is both a National Historical Park and a National Historic Landmark. According to the National Register Information System (NRIS), National Register of Historic Places (NRHP), National Register of Historic Districts (NRHD), and National Historic Landmark (NHL), the site is recorded as an archaeological and cultural resource for Kalawao County. The site is considered a NHL for the Kalaupapa Leprosy Settlement. The MBR site is currently owned by the State of Hawaii and managed by both the HDOH and the National Park Service (NPS). According to the State Historic Preservation Division (SHPD) website databases, there are archaeological/cultural resources recorded in the Kaunakakai (03) quadrangle map where the site is located. Specific locations of these areas are address-restricted due to the sensitive nature of these sites.

An archaeologist accompanying the 2013 RI field team confirmed there are numerous significant archaeological structures located throughout the MBR site (GANDA, 2013).

1.2.7 Demographics

The regional demographics information for the MBR was obtained from the 2010 US Census Bureau website: http://quickfacts.census.gov/qfd/. The Makanalua MBR is located in an unpopulated area on the northeast tip of the Kalaupapa Peninsula on the Island of Molokai. Kalawao County (located on the Kalaupapa Peninsula) is a separate county from the rest of Molokai, which is part of Maui County. The county does not have a county government, with the exception of a sheriff who is selected from local residents by the State Department of Health that administers the county.

The US Census Bureau 2010 population of Kalawao County is 90. The population density of Kalawao County is 7.5 persons per square mile. The median age is 55.3. The population consists of 26.7% White, 0% Black or African American, 0% American Indian or Alaskan, 7.8% Asian, 48.9% Native Hawaiian and Other Pacific Islander, 1.1% Hispanic or Latino, 26.7% of some other race, and 15.6% of two or more races. Over 26 inhabited structures are located within 2 miles of the FUDS boundary, all within the Kalaupapa settlement (U.S. Census Bureau, 2010).

1.2.8 Current or Future Land Use

The site currently lies within the Kalaupapa National Historical Park, owned by the State of Hawaii and managed by the NPS, Hawaii Department of Land and Natural Resources (DLNR), and HDOH. There is no recent development onsite. It is a significant historical and archaeological place and numerous archaeological sites are located throughout the entire site. No future development of the site is planned. Public access to the MRS is generally restricted; however, via permit and escort, people can access the area.

1.2.9 Biological Resources

According to the USFWS, the Hawaiian Islands support 344 federally listed Threatened and Endangered (T&E) species consisting of 71 animals and 273 plants. As stated by the Natural Resources Conservation Service (NRCS), of the 344 federally listed species, approximately 14 animal species and 62 plant species are known to occupy or potentially occupy the Island of Molokai; however, the habitat for most of these species is not present at the former MBR. According to the Division of Forestry and Wildlife 2005 Hawaii's Comprehensive Wildlife Conservation Strategy, the animal species of most concern for the Island of Molokai that are federally listed include: the Hawaiian hoary bat (*Lasiurus cinereus semotus*), Molokai thrush (*Myadestes lanaiensis*), ʻoʻu (*Psittirostra psittacea*), Maui parrot bill (*Pseudonestor xanthophrys*), Molokai creeper (*Paroreomyza flammea*), crested honeycreeper (*Palmeria dolei*), Hawaiian hawk (*Buteo solitarius*), Hawaiian goose (*Branta sandvicensis*), Hawaiian duck (*Anas wyvilliana*), Laysan duck (*Anas laysanensis*), Hawaiian common moorhen (*Gallinula chloropus sandvicensis*), Hawaiian stilt (*Himantopus mexicanus knudseni*), Hawaiian coot (*Fulica americana alai*), Hawaiian petrel (*Pterodroma sandwichensis*), Newell's shearwater (*Puffinus auricularis newelli*), and the Blackburn's sphinx moth (*Manduca blackburni*) (Parsons, 2008).

Two federally listed plant species, *Centaurium sebaeoides* and *Tetramolopium rockii*, are listed as inhabiting the eastern coastline within the site boundaries. The coastline area is considered critical habitat for these two plant species. Two zones of vegetation are present onsite. Near the shoreline, vegetation is limited in the coastal spray zone due to wind and salt spray. Invasive lantana (*Lantana camara*) and native naupaka kahakai (*Scaevola taccada*) grow abundantly. Further inland, the vegetation transitions to lowland dry/mesic plant communities dominated by invasive species which include Christmasberry (*Schinus terebinthifolicus*), lantana, and sourgrass. The predominant native plants were ʻilima and akia (*Wikstroemia uva-ursi*). Other native species were observed in relatively low frequency or in restricted distributions. These included the rare tree species, kolomana (*Senna gaudichaudii*), ohe kukuluāe o (*Polyscias sandwicensis*), and wiliwili (*Erythrina sandwicensis*). Culturally important Polynesian-introduced plants such as ti (*Cordyline fruticosa*) and auhuhu (*Tephrosia purpurea*) (Garcia, 2013).

1.3 PROBLEM IDENTIFICATION

Based on documentation, research, and the 2008 Site Inspection, the site is confirmed to have been used for aerial bombing, rocket, and strafing training by the US Navy beginning after

acquisition of permit in 1941 and continuing through October 1946. Prior to RI fieldwork, evidence of the target was identified in an area containing MEC (in the form of UXO (AN-Mk5 and AN-Mk19 practice bombs), and numerous expended practice bombs. Based on this information, the USACE determined that past uses of the MBR site related to munitions training may have resulted in an unacceptable explosive safety hazard or risk present at the site.

Land use controls (LUCs) require park visitors to obtain a permit and to be escorted by park personnel, but allow full access to the site.

Table 1-1 lists the MEC items known or suspected to be present based on historical records and findings previous site visits to MBR.

Table 1-1: MBR MEC Characteristics

Size	Nomenclature	Type
UXO found during 2008 SI at MBR		
3 lb.	AN-Mk5	Practice Bomb
13 lb.	AN-Mk19	Practice Bomb
Additional UXO Suspected per INPR and INPR Supplement		
3 lb.	AN-Mk23	Practice Bomb
4 lb.	AN-Mk43	Practice Bomb
5-inch	HVAR	Practice Rocket
3-inch	AP Mk 29	Projectile
	BLU 27	Fire Bomb
.30 and .50 caliber		Small Arms Ammunition

1.4 Historical Information

1.4.1 Site History/Military Activity

The Makanalua Bombing Range as currently reported in FUDSMIS consists of one MRS totaling 937 acres (832 land acres and 105 tidal water acres). (Note: Site acreage calculated with GIS is 713.25 acres (552.95 land acres and 160.30 tidal water acres). The acreages reported in the document and on maps use the GIS calculated acreage for this report. One bombing range and one rocket range overlap to form Range Complex No.1 MRS as shown on Figure 1-1.

Starting in 1865, the Kingdom of Hawaii began a policy of forced segregation of persons afflicted with Hansen's disease, also known as leprosy. The government purchased lands on the isolated Kalaupapa Peninsula and moved the Hawaiian residents to other homes. The village of Kalawao became home to thousands of victims of Hansen's disease. In the early 1900's, the Board of Health implemented a plan to provide high quality services, facilities, utilities, and medical care for patients at Kalaupapa. A major construction program began with construction of individual cottages, dormitories, hospital facilities, and other buildings. In 1946, improved drug therapies brought almost immediate reductions of Hansen's disease symptoms and vast

improvements in the quality of health and life for the people. Hansen's disease patients were no longer contagious and there was no further need for isolation. In 1969, the century-old laws were abolished. Former Hansen's disease patients living in Kalaupapa today have chosen to remain there, most for the rest of their lives.

The U.S. Navy acquired the MBR by permit in 1941 and used the site for bombing training until October 1946, when they abandoned the site and transferred the land permits back to the State of Hawaii. There are no records of any UXO clearances by the military after 1946. The acreage according to the original INPR consisted of approximately 160 acres. The 2004 INPR Supplement increased the acreage to 937 acres (See previous note regarding FUDSMIS vs. GIS calculated acreages) to include the bombing range and rocket range buffer areas. There is no historical evidence that Chemical Warfare Materials (CWM) are present on the MRS.

1.4.2 Property Ownership

The site is currently owned by the State of Hawaii, and managed by the NPS, Hawaii DLNR, and HDOH.

1.5 PREVIOUS INVESTIGATIONS

1.5.1 1991 Inventory Project Report

The INPR was completed by CEPOH in July 1991 (CEPOH, 1991). The INPR established the MBR as a FUDS, established the preliminary site boundary, and recommended an investigation to evaluate the presence of MEC. The Findings and Determination of Eligibility (FDE) for the site concluded that the MBR was utilized for bombing, rocket, and strafing training. A site survey was conducted in support of the INPR. The Trip Report for the 1991 INPR site survey reported the presence of MD, Mk23 4-pound practice bombs, 5-inch practice rockets, .50 caliber rounds, and napalm bomb fragments.

1.5.2 2004 INPR Supplement

The 2004 INPR Supplement summarizes the information from the 1991 INPR and other associated investigations. The INPR Supplement provides a summary of the MRS, redefined the boundary and increased the area of the MRS to 937 acres (718 land acres and 219 tidal water acres) (Note: this is not the currently reported FUDSMIS acreage, nor the. GIS calculated acreages), assigned the FUDS Project Number H09HI020301, and included other pertinent information concerning the munitions possibly used at the site. The INPR Supplement also provided a breakdown for the MRS with the standard range configuration based on the use of the MRS. Historical munitions use identified included small arms, practice bombs (AN-Mk5, AN-Mk23, AN-Mk43 with Mk4 or Mk5 signals), fire bombs (BLU 27), and rockets (5-inch HVAR). (CEMVR, 2004).

1.5.3 2008 Site Inspection

The 2008 Site Inspection was conducted to determine whether the site warranted further MEC or MC response action, or a determination of NDAI at the MBR site. Fieldwork conducted in July

2008 included 14.3 miles of qualitative reconnaissance and MC sampling of surface soil. Munitions-related items observed included unexpended practice bombs (two AN-Mk5 3-lb bombs and one AN-Mk19 13-lb bomb, all with explosive spotting signals) and other MD were found on the surface of the MRS. The site visit team also observed an expended 3-in. armor piercing naval projectile, possibly indicating that ship-to-shore artillery exercises were conducted here as well. However, no impact craters or other signs of naval artillery were discovered. Historical findings that the MBR was used as a practice bombing, rocket, and strafing target were confirmed. The MEC Screening-Level Risk Assessment concluded that a potential explosive safety risk is considered to be present at this MRS.

Soil sampling consisted of one incremental (IS) surface soil sample collected from a 160-acre Decision Unit (DU), comprised of 100 soil increments. The sample was collected in triplicate from a depth range of 0 to 2 in. bgs for analysis of potential MC (explosives, antimony, copper, lead, mercury, and zinc). An ambient surface soil sample (30- x 30-ft DU, 30 increments) was collected within the MRS in triplicate using the Incremental Sampling (IS) method. No groundwater or surface water samples were collected because there is no access to groundwater and no permanent surface water within the MRS. The IS surface soil samples were analyzed for explosives and selected metals. No explosive compounds were detected in any IS surface soil samples. Four MC metals (antimony, copper, lead and zinc) were detected in the surface soil sample at concentrations above ambient levels. As a result, a human health screening level risk assessment was conducted for the detected metals. The maximum concentrations of the metals were below the HDOH EALs for soil used for screening purposes. The risk assessment concluded that no unacceptable risks to human receptors are expected from exposure to the MC metals at the site, (Parsons, 2008).

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CHAPTER 2. PROJECTED REMEDIAL RESPONSE OBJECTIVES

2.1 CONCEPTUAL SITE MODEL

Preliminary Conceptual Site Models (CSMs) representing both MEC and MC were developed for the MBR site during the SI in accordance with Engineer Manual (EM) 200-1-12. The CSMs were developed only for the land portion of the MRS. Those CSMs were updated prior to the RI work plan and are presented below. The MEC CSM is presented as a summary table indicating known or suspected MEC/MC contamination sources, potential/suspected locations and distribution of contamination, related source or exposure media, current and future receptors, and potentially complete exposure pathways, and planned fieldwork (Table 2-1). The CSM for MC is presented as a flow chart that depicts the possible MC contaminant migration and exposure pathways for the various receptors (Figure 2-1).

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Table 2-1: Preliminary MEC Conceptual Site Model for Makanalua Bombing Range Prior to RI Fieldwork

Munitions Response Site Details	PRELIMINARY CONCEPTUAL SITE MODEL SUMMARY					REMEDIAL INVESTIGATION TECHNICAL APPROACH			
	Known or Suspected Contamination Source(s)	Potential/Suspected Location and Distribution	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway	Investigation Method	Investigation Location(s)	Planned Investigation Acreage/Number of Samples	Decision Rule(s)
NAME: Makanalua Bombing Range **RANGE COMPLEX 1** **Acreage: 832 (land)** **105 (tidal water)**[4] **Suspected Past DoD Activities (*release mechanisms*):** Bombing and Rocket Range **Current and Future Land Use:** Recreational	**MEC**: Terrestrial Small Arms; Practice Bombs (AN-Mk5, AN-Mk23, AN-Mk43); Fire Bombs (BLU 27); Rockets (5-inch HVAR)	Significant evidence of MEC hazards remaining; Heavy concentration at bombing target center.	Surface or subsurface soil	Site visitors Anticipated Recreational Use: hiking. No Intrusive activities are anticipated.	Handling of surface or subsurface MEC.	Physical inspection and intrusive investigation	Transects across MRS at approximately 250-foot spacing.	Survey 14.6 miles (8.4 acres) of transects and 1 acre of grids Physical inspection: Investigate 4-foot wide swath through densest part of pile	If data concentrations depict a bombing target, investigate 8 transects radially from target center to establish outer boundary. If major concentration of MEC suggest a bombing target, the project development team determines strategic locations for establishment of the equivalent of two 100-ft x 100-ft grids per target for determining MEC density.
	MEC: Tidal Water Small Arms; Practice Bombs (AN-Mk5, AN-Mk23, AN-Mk43); Fire Bombs (BLU 27); rockets (5-inch HVAR)	No evidence of MEC hazards, only a historic map showing extension of range into ocean.	Surface of ocean floor.	Divers	Handling of surface MEC.	None	None	None	If MEC found during terrestrial investigation suggests MEC presence in water, project development team will reconsider the need for underwater investigation. Surf along MRS boundary is dangerous for such an investigation.
	Munitions Constituents: Explosives and MC metals	Potentially present in soil.	Surface soil	Site visitors, ecological receptors Anticipated Recreational Use: hiking. No Intrusive activities are anticipated.	Exposure to MC in soil (incidental ingestion, dermal/root contact, inhalation of suspended particulates, and ingestion of biota).	Collect incremental soil samples and analyze for MC; conduct sampling at MEC-contaminated areas; if no MEC-contaminated areas, perform random sampling	Along transects	Confirmed target areas: 3 sampling units Background sampling: 2 sampling units placed in areas where no UXO/MD is found. Additional incremental or discrete samples as necessary to delineate extent of contamination.	If target areas confirmed, then collect increment soil samples (1 primary plus 2 replicates per sampling unit) to evaluate presence/absence of MC contamination. If MC metals concentration exceeds background concentration, then a comparison will be made to Preliminary Screening Values. If MC concentrations are below Preliminary Screening Values, then soil not MC-contaminated and no further analysis required. If MC concentrations exceed direct contact criteria, then collect subsurface samples to delineate vertical extent of MC contamination in soil, and additional surface samples to delineate horizontal extent; once delineation is complete, conduct MC risk assessment for soil pathway.
		Groundwater (*not expected but decision rules provided to address possibility*).	Groundwater (via leaching from soil)	None	None	None	None	None	
	MC (pre- and post-detonation) Explosives	At MEC detonation sites	Surface soil	Site visitors, ecological receptors	Exposure to MC in soil (incidental ingestion, dermal/root contact, inhalation of suspended particulates, and ingestion of biota).	Collect discrete soil samples and analyze for MC	MEC disposal locations	One pre- and one post-detonation sample per disposal location; up to 5 samples.	If MC analytes are detected in post-detonation samples at concentrations above preliminary screening values, then collect additional samples to delineate extent of MC contamination; once delineation is complete, conduct MC risk assessment for soil pathway
					Source 1 – INPR (1991) 2 – INPR Supplement (2004) 3 – Other Government Correspondence		BLU – Bomb Load Unit DoD – Department of Defense HVAR – High Velocity Aircraft Rocket INPR – Inventory Project Report		MD – Munitions Debris MC – Munitions Constituents MEC – Munitions and Explosives of Concern MRS – Munitions Response Site

4 – Note: Acreage division reported on original CSM (718 land and 297 tidal water) is not the acreage currently reported in FUDSMIS. Current acreage listed in table (832 land and 105 tidal water) is what is reported currently in FUDSMIS.

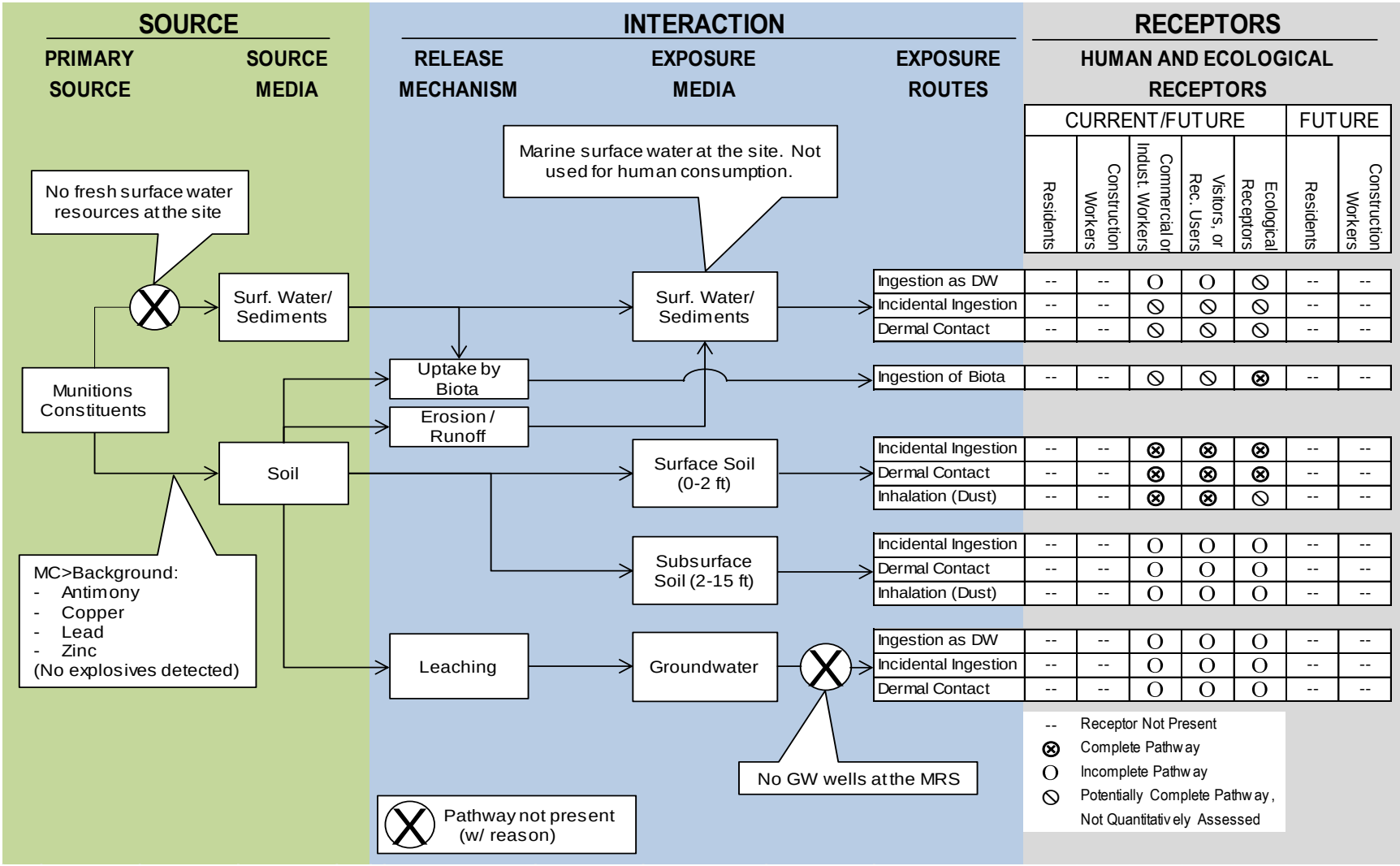

Figure 2-1: Preliminary MC Conceptual Site Model for MBR

2.2 PROJECT APPROACH

This section describes the RI project design and rationale to characterize the nature and extent of contamination from MEC and potential MC at the Range Complex No. 1 MRS. The approach was based on the findings of the 2008 SI recommendations and was designed to evaluate potentially complete MEC and MC exposure pathways as defined in the preliminary CSM. The approach is designed to evaluate the nature and extent of any contamination identified.

The horizontal boundaries for the RI/FS included the 552.95 land acres. The 160.30 acres in the tidal water area were not investigated do to rough sea conditions and the 2.22 acre Heiau was excluded for archaeological preservation (see Figure 1-1). The site was planned to be investigated with transects using analog metal detectors. Visual Sample Planning (VSP) software was used to plan transect spacing.

Horizontal boundaries for the MEC investigation cover the extent of the land acreage. Any potential target areas identified during the transect investigation, were planned to be investigated further by placement of two 100 ft by 100 ft grids.

Since the sea-state at the 160.30-acre tidal water portion of the MRS is too dangerous for physical investigation, no water investigation was planned or conducted.

Vertical extent of potential MEC contamination was established by the depth of anomaly detection or bedrock, whichever was reached first.

2.2.1 MEC Transect Investigation

The MEC transect investigation was planned to provide information for assessing explosive hazards, determining the need for additional evaluation or remedial action, obtaining data to evaluate remedial action alternatives, and selecting a remedy.

Visual Sample Planning (VSP) software was used for the land portion of the site to design the transect spacing sufficient to detect 500-ft-diameter target areas with 200 anomalies per acre above a background density of 10 anomalies per acre, at a 95% confidence level. Approximately 14.6 miles (8.4 acres) of transect survey using handheld analog metal detectors were planned to be conducted on nineteen 4-ft-wide transects that span the entire land portion of the MRS with a with 250-ft spacing. Depth of investigation was relegated to depth of anomaly detection. Planned transects are shown on Figure 2-2.

The following activities were planned:

- Vegetation cleared to within 6 inches of ground surface on investigation transects.
- Analog detection instruments to be used for detection and flagging of surface and subsurface anomalies that are potential MEC.
- Information from transect investigation were to be used to generate an anomaly density map of the MRS. High density areas, above a background density of 10 anomalies per acre, were to be further investigated with grids, using analog and flag & DGPS, and intrusive operations to determine if the high density area is MEC contaminated. 100%

grid investigations provide MEC types, densities, vertical extent, and production values necessary for the FS.

- If a target area was confirmed, the target area boundary was to be refined with radial analog and flag & DGPS, and intrusive operations to better define the extent of the target area. Portions of the MRS not associated with a confirmed target area to be assessed for low MEC densities using intrusive investigations of 10% of the reconnaissance transect segments, randomly selected. Note: Prior to field work, the work plan was modified to investigate 100% of all transect anomalies. The access transect provided investigation perpendicular to the planed transects.
- Data recorded would include locations of MEC and MD items discovered during the fieldwork would be recorded, and the items destroyed by demolition at the end of the fieldwork.

Past and present data would be processed through the MEC HA to score the MRS in order to determine whether further action is warranted and is necessary, further evaluated in a feasibility study.

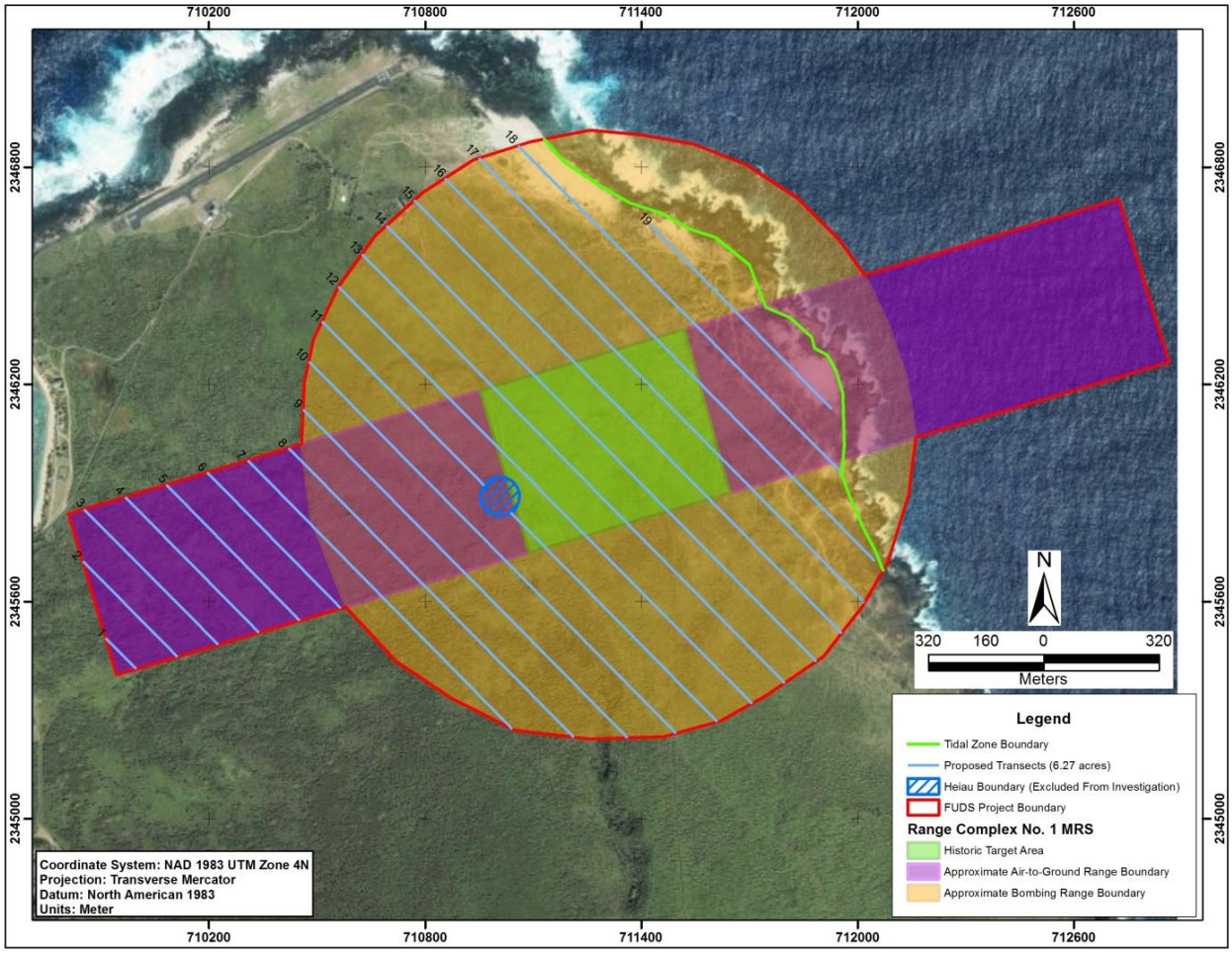

Figure 2-2: Makanalua Bombing Range Transect Map

2.2.2 Demolition

Ordnance items discovered during the investigation were geo-referenced. If MEC was encountered and determined by the Senior Unexploded Ordnance Supervisor (SUXOS) and UXO Safety Officer (UXOSO) that it is unacceptable to move, it would be marked and guarded, if necessary, until disposal could be accomplished. Consolidating multiple MEC was anticipated for this project.

A MEC item would only be moved if the SUXOS and UXOSO determined that the item is acceptable to move. Safety standards required that Unexploded Ordnance (UXO) deemed unacceptable to move would be blown in place.

If an item that could not be moved was located near an archaeological feature, the project team will refer to the Archaeological Monitoring Plan for a determination on how best to protect the features.

On-call explosives delivery provided by a local vendor and delivered via helicopter was planned for any MEC items recovered during operations.

A batch burner furnace, certified for burning Hazard Classification/Compatibility Group 1.4 material (NHES Batch Burner Furnace), was proposed as a secondary means of demilitarizing recovered MEC.

2.2.3 Munitions Potentially Presenting an Explosive Hazard Management

For munitions-related items encountered that were either not immediately identified as MEC or that could not be positively determined to contain explosives or other energetic materials, the following procedures were developed.

During field operations, MAJV recovered, inspected, certified through visual and thermal treatment, and disposed of Material Documented as Safe (MDAS). Details of the MD inspection process are provided in SOP 4 found in the MBR Work Plan (MAJV, 2013).

All inspection, certification, and final disposition procedures meet the requirements of Chapter 14, EM 1110-1-4009 and Errata Sheet No. 2. Upon turn-in of the MD, the SUXOS completed a DD Form 1348-1A. Both the SUXOS and the OE Safety Specialist (OESS) signed the DD Form 1348-1A to certify and verify inspection of the scrap. When the OESS was not on site to sign as the verifier, MAJV's UXOSO/UXOQCS verified the MD. Verified and certified MDAS items were packaged, sealed and shipped to Timberline Environmental Services (TES) for final disposal in July 2013 when the barge made its annual trip to the island. MAJV maintained the chain of custody of the sealed package until shipment to TES. As an element of cradle-to-grave documentation, TES will provide signed copies of receipt documents and the certificate of destruction when the material is completely processed. This documentation is to be included in the Final RI Report.

2.2.4 MC Sampling

MC sampling was planned to establish the presence or absence of MC contamination on the land portion of the site. If such contamination was identified, a secondary goal for MC was to determine the nature and extent of that MC contamination. Three IS sample DUs were to be focused in those areas with the highest anomaly densities and in confirmed areas of MEC contamination. Final sample locations were to be determined after the completion of the MEC survey. Two background IS sampling DUs were planned in areas of no MEC/MD findings to develop background comparison values for select MC metals concentrations in soil. Specific details on the sampling plan are presented in Chapter 3, Characterization of MEC and MC.

There are no freshwater resources or wells within the MRS, therefore per PDT concurrence, no surface water, sediment, or groundwater sampling was conducted.

2.2.5 Environmental Protection Plan

An Environmental Protection Plan was developed to establish general procedures for avoiding, minimizing, and mitigating potential impacts to environmental and cultural resources during field activities. The plan included both an Archaeological Monitoring Plan and a Natural Resources Monitoring Plan, both included in the appendices of the MBR Work Plan (MAJV, 2013). The plans called for a biologist and an archaeologist to be in the field accompanying the investigation teams to ensure protection of natural resources and archaeological features.

If protected species or archaeological features were identified, the field team was to evaluate the surrounding area to recommend relocation of inspection activities.

2.3 PRELIMINARY REMEDIATION GOALS AND OBJECTIVES

Site characterization goals for this RI were established for both MEC and MC.

Since the presence of an explosive hazard was established in the 2008 SI, the goal for MEC was to characterize the nature and extent of the MEC hazards. This goal was achieved by:

- Conducting analog reconnaissance transects on the land portions of the site.
- Developing an MRS anomaly density map.
- Conducting grid-based analog surveys in high anomaly density areas.
- Performing intrusive investigation of selected geophysical anomalies (100% grid anomalies and 10% random selected transect segment anomalies outside target areas). If a high-density area proves to be a target area, additional radial transects will be analog and dug to refine the extent of each target area. (Note: prior to fieldwork, this was changed to 100% investigation of anomalies along transects).

No investigation was planned for the water portion of the site due to the dangerous sea conditions. The data collected during this investigation is sufficient to conduct a hazard assessment for MEC on the site.

The goal for MC is to establish the presence or absence of MC contamination on the land portion of the site. If such contamination is identified, a secondary goal for MC is to determine the

nature and extent of that MC contamination. Initial sampling is focused in those areas with the highest subsurface anomaly densities and in confirmed areas of MEC contamination. If it has been determined that there is evidence that munitions activities at the site have resulted in a release of MC, then a human health and ecological baseline risk assessment will be conducted. The data collected during the sampling investigation will be sufficient to prepare a baseline risk assessment for MC.

An overall goal of the site characterization effort conducted during the RI is to produce sufficient data to facilitate future development and evaluation of any necessary remedial alternatives. The field investigation was designed to support this effort by including sufficient analog surveys and MC sampling. The RI/FS will be considered complete upon USACE acceptance of a Decision Document that meets the requirements of ER 200-3-1, Formerly Used Defense Sites (FUDS) Program Policy and EM-CX Interim Guidance Document 06-04.

2.4 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED INFORMATION

Section 300.430 (f)(l)(ii)(B) of the National Oil and Hazardous Substance Contingency Plan states that on-site remedial actions selected in a Record of Decision (ROD) must attain substantive requirements that are identified as applicable or relevant and appropriate requirements (ARARs) or must include a waiver of the identified ARARs under Section 300.430 (f)(l)(ii)(C). The ARARs are a compilation of the promulgated, substantive requirements of federal and state environmental laws that are legally applicable or are relevant and appropriate based upon the circumstances present at the project site as related to the release of MEC or MC contamination to the environment. The final ARARs are selected and become enforceable when the ROD or Decision Document for the site is signed. Non-promulgated criteria, advisories, guidance, and proposed federal and state standards known as "To Be Considered" (TBC) criteria are also considered. TBC criteria are not potential ARARs because they are neither promulgated nor enforceable. However, it may be necessary to implement TBCs when no ARARs exist for contaminants. In addition, it may become enforceable. There are three general types of ARARs: chemical-specific, location-specific, and action-specific. These three types of ARARs are discussed in the following three sections and Table 2-2Table 2-2 summarizes the ARARs and TBC criteria relevant for the MBR site.

2.4.1 Chemical-Specific ARARs

Chemical-specific ARARs typically rely on risk-based concentrations developed for site-specific conditions using generic contaminant exposure assumptions. The concentration levels developed typically correspond to concentrations of MC in soil, sediment, and groundwater above which these contaminants could pose a potential adverse threat to human health and the environment. Typical examples of this type of ARAR include the ambient water quality criteria and drinking water standards. There are no chemical-specific ARARs for MEC.

Groundwater, surface water, and sediments are not media of concern at the MBR site, so chemical-specific ARARs, such as the EPA maximum contaminant levels promulgated under the Safe Drinking Water Act, are neither applicable nor relevant and appropriate.

2.4.2 Location-Specific ARARs

Location-specific ARARs are restrictions on the types of activities that can be performed based upon site-specific characteristics or location of the project site. Common examples of this type of ARAR include site proximity to wetland or floodplains, or the presence of natural or cultural resources. The MBR site is located within the Kalaupapa National Historic Park and is considered a significant historical and archaeological place. Additionally, part of the site is located in the ecologically sensitive coastal spray zone. Two federally and state listed endangered animal species have habitats present onsite. The disposal of MEC could potentially disturb or destroy wildlife species known to be present in the area. The requirements specified in 16 United States Code (USC) 1538 require that steps must be taken to mitigate the impacts to endangered species that are substantive in nature.

2.4.3 Action-Specific ARARS

Action-specific ARARs are technology or activity-based requirements that are triggered by the type of remedial action under consideration for the project site. These action-specific ARARs need to be considered during design, operation, and management of work related to future removal actions at the project site. CERCLA regulations can be used as the authority under which a future munitions response action at the project site proceeds. Final action-specific ARARs will be determined by the USACE after coordination with the appropriate Federal and State agencies. Additional action-specific ARARs may be identified during preparation of the follow-on Feasibility Study.

Table 2-2: Makanalua Bombing Range RIFS ARARs

Regulator Authority	Location Characteristic	Regulation	ARAR or TBC	Synopsis	Action to be Taken to Attain Applicable Regulations to the Extent Practicable
Federal	Threatened and Endangered (T&E) Species	16 USC 1538, *(a)(1)(B)* Endangered Species Act of 1973	ARAR Location-specific	Requires protection of T&E species.	On-site Natural Resource Support (NRS) to accompany the field team for brush cutting and intrusive activities to identify sensitive species and assist in avoidance.
Federal	Archaeological Resources	Archaeological Resources Protection Act 16 USC 470 ee (a)	ARAR	Prohibits unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources	Onsite archaeologist to accompany the field team for brush cutting and intrusive activities.

2.5 SUMMARY OF INSTITUTIONAL ANALYSIS

An institutional analysis was completed as part of the characterization effort based on the requirements of EP 1110-1-24. This section identifies those government agencies having jurisdiction over the waters and properties within the former MBR. The Institutional Analysis assesses the identified authority of the institution, appropriateness, capability, and willingness to participate in the remedial alternative selected for the site. Table 2-3 Table 2-3summarizes the results of the institutional analysis.

Table 2-3: Government Agencies: Potential Institutional Alternatives

State of Hawaii Department of Land and Natural Resources	
Origin	State Government
Basis of Authority	State Law
Geographic Jurisdiction	State of Hawaii to include state waters (3 miles)
Public Safety Function	The State of Hawaii Division of Conservation and Resource Enforcement (DOCARE) possesses State of Hawaii resource enforcement to include the coastal waters, reefs, and shorelines.
Land Use Control	Division of Forestry and Wildlife: DOFOW is responsible for the management of State-owned forests, natural areas, public hunting areas, and plant and wildlife sanctuaries. Can limit access to target areas through signage and posting on website. Can participate in UXO awareness training for DOFOW employees. Division of State Parks: Responsible for permits allowing the use of recreational areas and providing access.
Desire to Participate	To be determined.
United States Coast Guard	
Origin	Federal Government
Basis of Authority	Federal Law
Geographic Jurisdiction	US Territorial Waters
Public Safety Function	USCG possesses a public safety and law enforcement function over vessels transiting within US Territorial Waters, issues Notice to Mariners when a risk has been identified, and updates nautical charts with caution boundaries.
Land Use Control	USCG can issue updates to Nautical Charts depicting the boundaries around the target islands that no anchoring or fishing should take place due to UXO presence.
Desire to Participate	Preliminary discussions with the USCG indicate the USCG would likely participate.

2.6 DATA NEEDS AND DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the characteristics of the data necessary to support decisions and the required quality of the data collected (EPA, 2006). The DQOs were developed through the Technical Project Planning (TPP) process during which the project objectives were refined. The resulting DQOs produced by this process meet the EPA definition of a DQO. The information below summarizes the final DQOs developed during the TPP process and was organized to follow the seven steps of the EPA DQO process.

The overall project DQOs, as developed in the initial TPP meeting held on March 13, 2012, were to obtain data to sufficiently characterize the nature and extent of any MEC or MC contamination present at the MBR, and to evaluate any potential MEC hazards or MC risks related to any identified contamination. Data obtained must also be sufficient to assess human health and ecological risks and to facilitate development of a future FS if risks must be addressed further.

The following DQOs were established prior to planning the RI.

2.6.1 Step 1 Problem Statement

2.6.1.1 MEC

Based on documentation, research, personal interviews, and the previous Site Inspection, the site is confirmed to have been used for aerial bombing, rocket, and strafing training. One bomb circle target has been located, containing MEC in the form of AN-Mk5 and AN-Mk19 practice bombs, and numerous expended practice bombs.

2.6.1.2 MC

The MC sampling conducted during the RI/FS is used to determine whether chemical releases to the environment related to the former use of the site as a bombing range led to the release of MC related contaminants at levels that exceed human and ecological environmental action levels (EALs). Chemical analyses for antimony, copper, lead, zinc, and explosives was evaluated by collection of IS samples from the project site to concentrations in surface soils (0-6 inches below ground surface [bgs]) within the project site. Non-chemical analyses was used to identify the extent of lead slugs in soil by visual identification and geophysical anomaly detection using digital electromagnetic geophysical surveys or analog metal detectors. The chemical data collected was evaluated to develop appropriate remedial response alternatives for the project site.

2.6.2 Step 2 Identify Decisions

2.6.2.1 MEC

- Determine the desired future land use for the site.
- Determine the appropriate investigation and cleanup criteria to support the desired future land and water uses.
- Determine if existing information is sufficient to support evaluation of cleanup alternatives which support desired future land and water uses.
- Determine if explosive hazard extends into the water portion of the site.
- Determine the nature and extent of the explosive hazard (hazard assessment) to current and future users.

2.6.2.2 MC

- Determine whether COPC concentrations in surface soil exceed background concentrations or risk-based screening criteria.
- Determine whether COPCs in surface soil, if present in excess of screening criteria and background concentrations, pose unacceptable risk to human health and/or the environment.

2.6.3 Step 3 Identify Information Inputs

2.6.3.1 MEC

Earlier studies have concluded that MEC are present on the land portion of the MRS site and that additional remedial action is necessary. No information exists as to whether MEC hazards extend to the water portion of the site. Information necessary to allow decision makers to address the decisions identified in Step 2 include:

- Existing data from previous investigations to include:
    - 1991 Inventory Project Report (USACE, 1991).
    - 2004 Inventory Project Report Supplement (USACE, 2004).
    - 2008 Site Inspection Report (Parsons, 2008).
- Additional surface and subsurface data to establish the horizontal and vertical extent of MEC within the MRS.
    - Reconnaissance transect surface and subsurface anomaly locations.
    - MRS anomaly density map with potential target areas identified and investigation grids designed.
    - Grid surface and subsurface intrusive results to establish the types, densities and vertical extent of MEC within target areas.
    - Confirmed target area boundary refining transect surface and subsurface intrusive results.
    - Randomly selected non-target area reconnaissance transect segment intrusive results.
- Data analysis which allows a determination as to whether MEC extends to the water portion of the MRS.
- Conceptual Site Model with desired future land uses defined.
- Cleanup/clearance requirements applicable to each potential land use to be evaluated.
- Limitations to data gathering such as topography, treacherous sea-state (unsafe for snorkeling or diving operations), vegetation, historic preservation issues, and detection technology.
- MEC Hazard Assessment (MEC HA) data necessary to support evaluation of each site, including the water portion.
- Production data to support cost estimates for future remediation efforts.

2.6.3.2 MC

The following data and information will serve as the basis for making the decisions identified above:

- Chemical concentration data for surface soil samples collected from the former Makanalua Bombing Range site.
- Locations of all surface soil samples collected from the former Makanalua Bombing Range site.
- Triplicate surface soil increment samples collected from each of three sampling units (along transects through confirmed target areas with an estimated size between 25 to 50 acres) located within the project site, for a total of nine increment samples.
- Triplicate surface soil increment samples from two background sampling units located adjacent to the identified target areas where MEC and/or MD are discovered during the MEC surveys, for a total of six increment samples.
- Screening levels based on:

  DOH Tier 1 EALs selected for soil where the potentially impacted groundwater is not a current or potential drinking water resource and a surface water body is located less than 150 meters from the release site (DOH 2009a).
- Results of human health and ecological risk screening assessments, if warranted.
- Field observations and field-recorded Unified Soil Classification System soil descriptions.

2.6.4 Step 4 Define the Boundaries of the Study

2.6.4.1 MEC

The horizontal boundaries for the RI/FS include the entire 937-acre site, of which 832 acres are on land and 105 acres are in the water (Per FUDSMIS). Visual Sample Planning (VSP) software used for the land portion of the site to design this transect spacing sufficient to detect 500-ft diameter target areas with a 200 anomalies per acre above a background density of 10 anomalies per acre, at a 95% confidence level. The PDT planned for at least two target areas within the MRS. Horizontal boundaries for the MEC investigation cover the extent of the land acreage. Any potential target areas identified during the MEC investigation, based on reconnaissance transect surface and subsurface anomaly densities over the entire MRS were planned to be investigated by grids. If the area is confirmed to be a target area, it was planned they would be further investigated by radial transects to determine their horizontal extent. Horizontal boundaries for subsurface investigations will be 100-foot by 100-foot grids (or equivalent area as dictated by field conditions) established in the field based on anomaly density data, 2 grids to each potential target area: 1 grid located at the highest density portion of the potential target area and the remaining grid area spread within medium and low density portions of the potential target area.

Since the sea-state at the 105-acre water portion of the MRS is too dangerous for physical investigation, MEC density near the land/water boundary of the MRS was used to determine whether the horizontal boundary for MEC extends into the water.

Vertical extent of MEC investigations extend from the surface to the maximum depth of detection of the geophysical instruments or to bedrock, whichever is reached first.

2.6.5 MC

Sampling unit boundaries were established based on: the MEC/MD boundaries delineated during the MEC survey, the presence of available media (i.e., surface soil), and consideration of sensitive habitats. Increment samples were collected from the sampling units in accordance with the HDOH Technical Guidance Manual (TGM) (HDOH, 2009b). Each IS sample to consist of 100 sub-increments collected along survey transects that run through identified target areas. Sub-increments from IS samples were located in a systematic-random manner (e.g., equal spacing along the MEC survey transects traversing the area with a random starting point).

Two background sampling units were established at the project site for determination of select background metals concentrations in soil. The background sampling units were located in areas not impacted by MEC or MD that contained soil similar in composition to the soil found within the identified target areas.

The final MC sample locations were determined after the completion of the MEC survey.

2.6.6 Step 5 Develop the Approach (Decision Rules)

2.6.6.1 MEC

The project approach for assessing explosive hazard, determining the need for additional evaluation or remedial action, obtaining data to evaluate remedial action alternatives, and selecting a remedy was based on analog investigation.

- Vegetation was to be cleared to within 6 inches of ground surface.
- Analog detection instruments to be used for detection and flagging of surface and subsurface anomalies that are potential MEC. Reconnaissance transect flag locations (surface and subsurface) to be used to generate an anomaly density map of the MRS. High density areas, above a background density of 10 anomalies per acre, to be further investigated with grids, using analog and flag & DGPS, and dig operations to determine if the high density area is MEC contaminated. 100% grid investigations provide MEC types, densities, vertical extent, and production values necessary for the FS. If a target area is confirmed, the target area boundary is refined with radial analog and flag & DGPS, and dig operations to better define the extent of each target area. Portions of the MRS not associated with a confirmed target area are assessed for low MEC densities using intrusive investigations of 10% of the reconnaissance transect segments, randomly selected.

Note: Per USACE request, the original plan was altered to 100% intrusive investigation of all anomalies found identified using analog instruments. GPS coordinates of all MEC items to

be captured in the Personal Digital Assistant (PDA). This alleviated concern over the QA process validating removal and provided more comprehensive investigatory data on which to base future decisions.

- Locations of MEC items discovered during the fieldwork were to be recorded, and the items will be destroyed by demolition or thermal treatment if possible at the end of the fieldwork.
- If an item that cannot be moved is located near an archaeological feature, the project team will refer to the Archaeological Monitoring Plan for a determination on how best to protect the features.
- All past and present data to be processed through the MEC HA to score sites in order to determine whether they should receive no further action or be further evaluated in a feasibility study.

2.6.6.2 MC

The following four decision rules will be applied relating to the MC sampling results in the RI and to further action, if proposed for this project:

- If individual MC metal concentration measured in the increment samples exceed background concentration, then the analyte will be identified as a COPC, and a comparison will be made to Preliminary Screening Values.
- If COPC concentrations in the surface soil increment samples exceed risk-based screening criteria, then human health and/or ecological risk screening assessments will be conducted. Conversely, if COPC concentrations in surface soil do not exceed risk-based screening criteria, then no human health or ecological risk screening assessments will be necessary and NFA will be recommended for soil.
- If the risk screening assessment results indicate that COPCs in soil pose unacceptable risk to human health and/or the environment, then the need for further remedial action at the site will be evaluated in the FS. Conversely, if the risk screening assessment results indicate that COPCs in soil do not pose unacceptable risk to human health and/or the environment, then NFA will be recommended for MC contamination for the former Makanalua Bombing Range site.

2.6.7 Step 6 Specify Performance or Acceptance Criteria

2.6.7.1 MEC

Completion of RI MEC sampling in accordance with the MBR work plan or adjusted process agreed to (in advance) by the Project Team.

Visual Sampling Plan software, UXO Estimator or other approved statistical method are used to calculate the following statistical confidence levels:

- Layouts of transects are designed to demonstrate that all target areas with elevated anomaly density (200 anomalies per acre above a background of 10 anomalies per acre and with a spatial extent of 500-ft diameter or greater) with the greatest potential to

contain MEC, will have been traversed at the completion of fieldwork and that there is a 95% chance of detecting these areas. Loading "as built" transects back into VSP will confirm coverage.

- There will be a 95% confidence level that areas classified as MEC-contaminated have greater than or equal to 0.5 UXO per acre. Post intrusive results are used to generate MEC and MD density maps.
- There will be a 95% confidence level that these areas are delineated to an accuracy of at least +/- half the transect spacing, maximum 250 ft using the grid intrusive results and the refining radial transect intrusive results.

Analog metal detectors must be capable of detecting and locating anomalies to the depths defined by the Instrument Test Strip (ITS) process and the results will be presented in an ITS report.

Operators must be able to detect all ITS seed items within 1 ft of their known locations.

The DGPS must be capable of providing accurate location information. Daily checks at a known location to be used to document DGPS is providing location data within 2 m.

Metal detectors and positioning equipment must be functional in rugged terrain and must remain operational in inclement weather. Other factors used to evaluate equipment performance may include the relative influence of magnetic geological features on the equipment performance, ease of operation, and the use of blind seeds.

The MAJV field team will survey in transect points and grid corners to an accuracy of 3.28 feet.

Data collection must support application of the MEC HA in accordance with the project-specific documentation developed for MBR.

2.6.7.2 MC

The performance and acceptance criteria for MC sampling and analysis area specified in the MC Sampling and Analysis Plan QAPP appended to the MBR work plan.

2.6.8 Step 7 Develop the Plan for Obtaining Data

2.6.8.1 MEC

The MEC investigation design was developed to optimize resources and generate data to satisfy the project DQOs. The sampling plan for investigating MEC and the quality and performance standards were established in the MEC Sampling Plan appended to the MBR Work Plan. The plan for data collection and the detailed description of how data will be obtained, processed, and interpreted and the quality control measures are detailed in that document and summarized in the preceding DQO steps.

2.6.8.2 MC

The MC sampling design was developed to optimize resources and generate data to satisfy the project DQOs. The critical task was to identify areas of the site where COPC concentrations, if

present, exceed the PAL. The PALs were based on the current HDOH Tier 1 EALs (HDOH 2011). The collected data will be used by CESPK, CEPOH, and HDOH to identify COPC concentrations that exceed the PALs, calculate human health and ecological risk, and determine whether further action is necessary at the site.

The sampling design used for this RI is based on the DQOs, historical knowledge and sampling results, estimates of variance, characteristics of the contaminant, and the primary modes of contaminant transport.

The COPCs evaluated during the RI/FS included MC Metals (Antimony, Lead, Copper and Zinc), and explosive compounds. These analytes were selected for analysis during the SI (Parsons, 2008) based upon the chemical composition of the munitions reported to have been used and observed at the Makanalua Bombing Range.

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CHAPTER 3. CHARACTERIZATION OF MEC AND MC

This chapter provides details of the approach, methods, and operational procedures for field activities conducted for the characterization of MEC and MD at the former MBR. The original technical approach with full details for the field investigation was described in the RI WP (MAJV, 2013) and summarized in Chapter 2.0.

3.1 MEC CHARACTERIZATION

3.1.1 Area Investigated

The area investigated included the nineteen 4-ft-wide transects originally planned that covered the entire land portion of the site and were developed in VSP. The 2.22 acre Heiau was excluded from investigation.

The planned grid investigation and radial transects were substituted with 0.26 acres (0.54 miles) of 100% investigation of the access transect (A-1). The field tracks of investigation are shown on Figure 3-1.

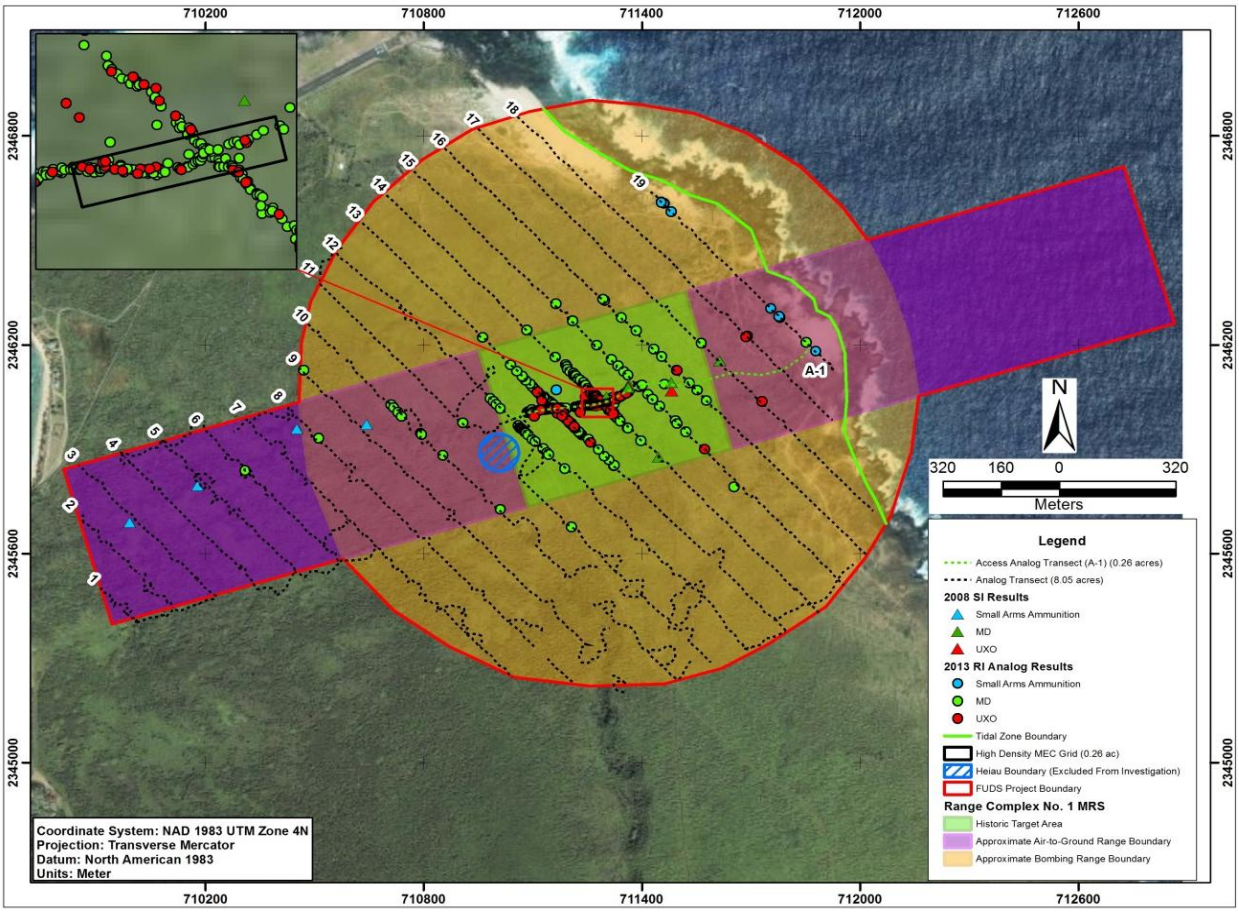

Figure 3-1: RI Intrusive Results

3.1.2 Positioning Transects

Transects were positioned using the Trimble GeoXT by qualified field personnel.

An archaeologist and field biologist from GANDA accompanied the team to assist in the identification of significant archaeological structures and sensitive natural resources. Significant items were flagged to avoid unintended disturbance.

3.1.3 Vegetation Clearance

Prior to transect investigation, brush was cut to a height of 6 in. Work on transects in the coastal spray zone, a sensitive habitat, avoided cutting any Hawaii native plants. The area where no vegetation was cut was approximately 650 feet from the shore line and included all of transects 18 and 19, and parts of transects 16 and 17. In non-coastal areas, Hawaii native plants not considered endangered or part of critical habitat were cut. Critical cultural and natural resources identified by GANDA personnel were avoided.

Due to the extreme terrain and thick vegetation encountered at inland areas of the site, vegetation clearance production rates were less than expected.

3.1.4 Transect Investigation

The transect investigation was accomplished using the handheld Minelab Explorer II analog metal detector. The transect survey was conducted as planned in the areas within the Target Area; 100% of identified anomalies were investigated to depth of detection.

Per PDT approval, the following changes were made to the intrusive investigation.

- The areas outside the Target Area were changed from intrusive investigation of 10% of anomalies outside of the target area to investigation of 100% of anomalies. This was done for accommodate QC considerations.
- The originally planned grid acreage was revised to be conducted as 100% investigation of the access transect (A1). The access transect traversed throughout the center of the target area and beyond to assist in delineating extent perpendicular to the planned transects.

VSP was used to determine that 4 foot wide transects with a parallel pattern spaced 103 meters between transects have an approximately 95% chance of traversing and detecting any 500 foot diameter circular target with an average density of 200 anomalies per acre above the background density of 10 anomalies per acre.

The transect miles completed were 17.14 miles, equaling 8.31 total acres. Transects were relegated to a 4-ft width and depth of anomaly detection. All transects were 100% investigated for surface and subsurface. The investigation resulted in the discovery and removal of 99 MEC items (in the form of UXO) and 1,024 lbs of MD. In some instances, multiple items were found at the same anomaly location.

The munitions items encountered match the information contained in prior investigation reports with respect to both munitions type and location.

Vegetation and terrain conditions through the majority of the work were extreme. The daily production rates of the Transect Anomaly Investigation were less than anticipated as shown in the Production Log in Appendix A.

3.1.5 Intrusive Investigation Results Sheet

Results of the intrusive investigation were documented in the Intrusive Results Sheet, which includes all required information. The Intrusive Results Sheet is located in Appendix J.

3.1.6 QC Instrument /Equipment Testing

An instrument verification strip was developed for the daily inspection of instruments prior to daily operation and documented on the QC checklist found in Appendix C.

Quality Control of field procedures included:

- Reacquisition of 46 seed items placed throughout the site. 100 % of all seed items were recovered.
- UXOQC documentation of anomaly clearance. 100 % of anomalies were successfully cleared.
- Daily Equipment Testing. The Trimble GeoXT used for positioning transects was tested daily on a known point. The Minelab Explorer II analog metal detector was tested daily on the ITS. Documentation is found in the Daily QC reports and in the Table of Intrusive Results both appended to the report.

3.1.7 Disposition of UXO Items

The 99 UXO items encountered were destroyed thermally in the Batch Burner Furnace Thermal Treatment Unit (TTU). Following thermal treatment, the items were inspected by qualified personnel, and classified as Material Documented as Safe (MDAS). The MDAS was disposed of according to the requirements of Chapter 14, EM 1110-1-4009 and Errata Sheet No. 2.

3.1.8 Disposition of Material Documented as Safe

The munitions-related items encountered that were not classified as MPPEH were recovered, inspected, classified as MDAS and disposed of per the requirements of Chapter 14, EM 1110-1-4009 and Errata Sheet No. 2.

Verified and certified MDAS items were packaged and sealed, and shipped to Timberline Environmental Services (TES) for final disposal in July 2013. Documentation on DD Form 1348-1A is included in Appendix E.

As an element of cradle-to-grave documentation, TES provided signed copies of receipt documents and the Certificate of Destruction. This documentation is included in Appendix E.

3.1.9 Photographic Log

Photographs documenting site conditions, munitions found, and site activities are located in Appendix D.

3.2 MC CHARACTERIZATION

Environmental sampling was conducted at MBR to determine whether historic usage of the area as a bombing and rocket range resulted in detectable levels of MC in site soils. MC may be present in the shallow soils within the former MBR at historic impact areas (where detonations occurred) and firing points. MC may occur in the form of leachate or fragments of the metals that encased the explosives, and from release of the chemicals used for producing an explosion or signal to the environment. IS soil sampling was conducted at MBR. The IS sample locations were based on the MEC density map produced after RI transect investigation. Potential MC that may be present in the shallow soils at MBR include four MEC-related metals [antimony (Sb), copper (Cu), lead (Pb), and zinc (Zn)], as well as explosive and propellant compounds. These metals and explosive compounds are the Chemicals of Potential Concern (COPCs) for the Project Site.

3.2.1 Purpose of MC Sampling Activities

The overall objective of the MC sampling work was to determine whether MC contamination exists at the site and, if present, whether the MC contamination poses an unacceptable risk to human health and the environment. The MC data collected during this RI is a component of the site-specific information used to select an appropriate response alternative for the site.

3.2.2 Preliminary Screening Values

The MC data obtained from the near-surface soils present at the former MBR was compared to HDOH Tier 1 EALs. Tier 1 EALs are soil concentrations (of metals and explosives for this Project Site) below which these compounds have been determined to not pose a significant threat to human health or the environment (HDOH, 2008, 2011a). The EALs are dependent on the environmental setting in which the sampled soils are located. For the former MBR Site, the following environmental setting was assumed: "groundwater affected or potentially affected by the release is not a current or potential drinking water resource and the site is located within 150 meters of a surface water body (EAL, Table B-2)." The groundwater beneath the former MBR is not potable and the eastern half of the former bombing range is located within 150 meters of the Pacific Ocean.

3.2.3 Field MC Sampling Activities Summary

The sampling guidance issued by the overseeing regulatory agency, HDOH, recommends the collection of IS samples to determine representative contaminant concentrations at environmental sites (HDOH 2009, 2011a). According to these guidance documents, increment samples, consisting of a minimum of 100 sub-samples collected from DUs established within the area being characterized, generates a more representative MC concentration of the sampled area, compared to discrete sample data.

The IS sample collection followed current HDOH guidance for former maneuver area/bombing range sites with a minimum of 10 percent of the total acreage being sampled using DUs of a maximum size of 10 acres. Five DUs of 200-m by 200-m dimension (40,000 m^2, or about 9.9

acres) were established at the former MBR site (Figure 4-2). The 200-m dimension of each DU allowed the collection of sub-increment samples from along three MEC transects within each DU. The final locations of the DUs were established after the initial MEC surveys were completed and areas that contained sufficient near-surface soil to sample were delineated. Much of the surface at the site consisted of volcanic rock that contained a very thin (typically 3 in. thick or less) layer of hard, dry, reddish-brown silty clay.

Three of the DUs (DUs 2, 3 and 5) were established in areas containing surface soil where MEC and MD were encountered during the visual and geophysical MEC surveys completed at the site. DU-3 was centered in the portion of the site that was found to contain the highest amount of MEC and MD while DUs 2 and 5 contained relatively minor amounts of MEC and MD. The remaining two DUs (DUs 1 and 4) were established in the surrounding background areas where no evidence of MEC or MD was encountered during the MEC surveys.

The soil sampling work was conducted on April 1 and 2, 2013. IS samples were collected from the sampling units in accordance with the HDOH Technical Guidance Manual (TGM) (HDOH, 2009). Each increment sample consisted of a total of at least 100 sub-increments collected along three MEC survey transects that ran through each delineated DU. The sub-increment samples were collected in a systematic-random manner (i.e., equal spacing along the MEC survey transects traversing the area with a random starting point). Triplicate increment samples were collected from four of the five DUs established within the former MBR. The two replicate increment samples were collected in the same manner as the primary increment sample, but from a different starting point, and thus no sub-increment was collected from exactly the same spot.

The IS samples were collected from the shallow near-surface (0 to 3 in. bgs) soils present at the site using a dedicated trowel to break-up the hard soil and to transfer equal volumes of soil per increment into a dedicated, disposable polyvinyl chloride (PVC) end cap. The trowel was used due to the rocky nature of the soil. The sampling interval corresponds to the entire depth of soil present at the site and represents the material that site users may potentially be exposed to during normal everyday activities. The size of the PVC cap was selected to hold approximately 15 g of soil. Each 15-g increment, collected from more than 100 sub-increments present within each DU, was placed into a pre-labeled, food-grade, re-sealable plastic bag, producing an approximately 1.5-kg increment sample that was submitted to the analytical laboratory for chemical analysis. The PVC end cap and hand trowel were discarded after each increment sample was collected in order to prevent cross-contamination, and to eliminate the need for decontaminating sampling tools between sample collection points.

3.2.4 Sample Management

Upon collection in the field, the IS samples were assigned a unique Environmental Protection Agency (EPA) identification (ID) number, and a label with the ID number, and the date and time of sample collection was affixed to the food-grade, re-sealable plastic bag that was used to hold the collected sample. Following sample collection, the samples were double-sealed and placed in a refrigerator for temporary storage on Molokai, to allow the samples to be maintained as close to 4 degrees Celsius (°C) as possible from the time of collection through sample transport.

After the samples arrived back on Oahu, the double-bagged, re-sealable bags were packed with gel ice for shipment to the mainland laboratory. The original COC form and a copy of the current laboratory's United States Department of Agriculture (USDA) Soil Import Permit were placed in a re-sealable bag and included in the cooler with the samples. Two custody seals were placed on a hinge and front lid of the cooler. Custody seals were also placed on each sample bag to ensure proper COC controls in the event that the cooler was opened for inspection.

Samples were collected from the former MBR on April 1 and 2, 2013 and were shipped to Test America Sacramento by priority overnight express courier (FedEx). The laboratory received the samples on April 5, 2013. A copy of the sample inventory log from the laboratory is provided in Appendix I.1.

3.2.5 Analytical Laboratory and Analyses

The IS samples were submitted to the Test America-Sacramento office for chemical analysis. The 1.5-kg samples were screened and split in the laboratory to produce representative samples that were digested or extracted for analysis. The IS samples were prepared in accordance with the HDOH TGM (HDOH, 2009) guidance for laboratory sub-sampling protocol for preparation of IS samples.

The sample preparation steps specified below were followed for the IS samples analyzed for metals content.

- Place the entire sample on a tray covered with aluminum foil and air-dry for a minimum of 24 hours in a fume hood.
- Carefully sieve the entire air-dried sample using a 2-millimeter (mm) sieve.
- Evenly distribute the sieved, air-dried sample onto another tray covered with aluminum foil.
- Form an imaginary 6 by 5 grid over the tray and take an aliquot composed of approximately 1/30th of the desired target mass (10 g) from each imaginary grid square in the tray.
- Collect an approximately 10-g soil sample for digestion for metals analysis.

The sample preparation steps listed below were followed for the increment sample that was analyzed for explosive compounds content.

- Using a Pulverizing Mill (ring and puck), ESSA model LM2-P, powder the remaining (roughly 1.5-kg) of air-dried sample from which the metals sample has been removed.
- Evenly distribute the powdered sample onto a tray covered with aluminum foil.
- Form an imaginary 6 by 5 grid over the tray and take an aliquot composed of approximately 1/30th of the desired target mass (10 g) from each imaginary grid square in the tray.

- Collect approximately 10 g of the pulverized soil sample for extraction for determination of explosives content.

The concentration of Cu, Pb, and Zn in the IS samples was determined using inductively coupled plasma-atomic emission spectroscopy following preparation by EPA Method 3050B and analysis by EPA Method 6010B. Antimony was analyzed by inductively coupled plasma-atomic spectroscopy/mass spectrometry using EPA Method 6020A. The concentration of explosives in the IS samples was determined using high-pressure liquid chromatography following EPA Method 8330B.

3.2.6 QC/QA Samples

Quality Control/Quality Assurance (QC/QA) samples were collected and analyzed to assess sampling precision and potential cross-contamination, which may occur between the time of sample collection and laboratory analysis. The results from the QC samples also provided information regarding the variability of the sampled population. QC samples for this site investigation included field triplicates, matrix spike/matrix spike duplicate (MS/MSD) samples, and temperature blanks.

3.2.6.1 Field Triplicates

For IS sampling, field triplicates were collected (Appendix A of EPA SW-846 8330B) in the same manner as the original sample, with the same number of increments and volume. The triplicates become additional IS samples. The triplicates were collected from DU-1, DU-2, DU-3, and DU-4 in order to perform a statistical analysis on the collected data [i.e., Relative Standard Deviation (RSD)] to assess the precision of analytical results.

3.2.6.2 MS/MSDs

MS/MSD samples are used to assess interferences in analytical results caused by the sampled matrix. The analytical laboratory spikes the MS/MSDs with known concentrations of all the target analytes and then analyzes the MS/MSDs. The percent recovery is calculated and is used to evaluate interference effects.

One sample for MS and one sample for MSD were analyzed for every 5 percent of the total number of samples; one MS/MSD sample pair was analyzed for every 20 field samples collected. The MS/MSD analysis was performed on project-specific samples; a portion of field sample MBR-01 was utilized as MS/MSD samples, and were identified as MBR-01MS and MBR-01MSD. Since IS samples are significantly larger than discrete samples, enough soil was available to perform all MS/MSD analyses.

3.2.6.3 Temperature Blanks

One temperature blank sample consisting of a plastic container filled with tap water supplied by the laboratory was included in the cooler of samples shipped back to the laboratory. The temperature of the blank was used by the laboratory as the representative temperature of the samples within the cooler.

CHAPTER 4. REVISED CONCEPTUAL SITE MODEL AND REMEDIAL INVESTIGATION RESULTS

The sections below discuss the results of the 2013 RI fieldwork. The source, nature, and extent of MEC contamination, the identification of no MC contamination, and the potential exposure pathways for each medium are presented. The rationale for delineation of the MRS based on the intrusive results follows.

4.1 RESULTS FOR MUNITIONS AND EXPLOSIVES OF CONCERN

This section presents the results of the RI concerning MEC. The results are presented in a table of findings from the transect survey, maps showing the lateral extent of the MEC and MD findings, the density map of MEC and MD, and an evaluation of MEC exposure pathways.

4.1.1 Results of Intrusive Investigation

The results of the intrusive investigation of 19 planned transects (1-19) and the access transect (A-1) are presented in Appendix J. The results are presented associated with the anomaly number along each transect. No unexpected munitions were encountered. MEC was encountered in the form of UXO, no DMM or explosive soils were encountered.

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Table 4-1: Results of Intrusive Investigation

	MEC (in form of UXO)				MD		
Transect	Anomaly #	UXO Items	# of Items	Depth (in.)	Items [1]	Wt. (lb)	Depth (Range)
1-5	-	None	-	-	None	-	-
6	-	None	-	-	Unidentifiable Frag	0.25	0
7	-	None	-	-	None	-	-
8	-	None	-	-	3 lb Practice Bomb, AN-Mk 23 (frag)	0.5	3
9	-	None	-	-	3 lb Practice Bomb, AN-Mk 5 (intact)	3	0
10	-	None	-	-	3 lb Practice Bomb, AN-Mk 5 (2 intact+frag), 3 lb Practice Bomb, AN-Mk 23 (frag), 4.5 lb Practice Bomb, AN-Mk 43 (1 intact+frag)	18.5	0-4
11	-	None	-	-	3 lb Practice Bomb, AN-Mk 5 (frag), 4.5 lb Practice Bomb, AN-Mk 43 (frag)	1	1
12	-	None	-	-	3 lb Practice Bomb, AN-Mk 5 (1 intact+frag), 3 lb Practice Bomb, AN-Mk 23 (frag), 4.5 lb Practice Bomb, AN-Mk 43 (1 intact+frag). 13 lb Practice Bomb, AN-Mk 19 (frag)	26.5	0-12
13	13-083	3 lb Practice Bomb, AN-Mk 5	1	6	3 lb Practice Bomb, AN-Mk 5 (3 intact+frag)	149	0-18
	13-039	3 lb Practice Bomb, AN-Mk 23	1	1	3 lb Practice Bomb, AN-Mk 23 (9 intact+frag)		
	13-011	3 lb Practice Bomb, AN-Mk 5	1	18	4.5 lb Practice Bomb, AN-Mk 43 (frag)		
	13-020	3 lb Practice Bomb, AN-Mk 5	1	6	13 lb Practice Bomb, AN-Mk 19 (1 intact+frag)		
	13-001	3 lb Practice Bomb, AN-Mk 5	8	0			
	13-004	3 lb Practice Bomb, AN-Mk 23	2	0			
14	14-108	3 lb Practice Bomb, AN-Mk 5	1	0	3 lb Practice Bomb, AN-Mk 5 (1 intact+frag)	252	0-18
	14-056	3 lb Practice Bomb, AN-Mk 23	3	1	3 lb Practice Bomb, AN-Mk 23 (2 intact+frag)		
	14-077	13 lb Practice Bomb, AN-Mk 19	4	12	4.5 lb Practice Bomb, AN-Mk 43 (frag)		
	14-079	3 lb Practice Bomb, AN-Mk 23	1	0	13 lb Practice Bomb, AN-Mk 19 (frag)		
	14-084	3 lb Practice Bomb, AN-Mk 23	1	4	Unidentifiable Frag		
	14-101	3 lb Practice Bomb, AN-Mk 23	1	6			
	14-029	3 lb Practice Bomb, AN-Mk 23	1	6			

	MEC (in form of UXO)				MD		
	14-033	3 lb Practice Bomb, AN-Mk 5	1	0			
	14-039	3 lb Practice Bomb, AN-Mk 23	1	0			
	14-040	3 lb Practice Bomb, AN-Mk 23	1	12			
	14-045	3 lb Practice Bomb, AN-Mk 23	1	1			
	14-047	3 lb Practice Bomb, AN-Mk 23	2	18			
15	15-019	3 lb Practice Bomb, AN-Mk 23	1	0	3 lb Practice Bomb, AN-Mk 5 (1 intact+frag)	27	0-12
					3 lb Practice Bomb, AN-Mk 23 (2 intact+frag)		
					Unidentifiable Frag		
16	16-005	13 lb Practice Bomb, AN-Mk 19	1	10	3 lb Practice Bomb, AN-Mk 5 (frag)	28	0-18
					3 lb Practice Bomb, AN-Mk 23 (frag)		
					13 lb Practice Bomb, AN-Mk 19 (frag)		
					Unidentifiable Frag		
					One Bomb Ejector Rack (intact)		
17	17-001	13 lb Practice Bomb, AN-Mk 19	1	0	Unidentifiable Frag	1	3
18	18-002	3 lb Practice Bomb, AN-Mk 23	1	0	3 lb Practice Bomb, AN-Mk 23 (tail fin)	1	6
19		None			Unidentifiable Frag	26.2	0-12
					Expended Small Arms Ammunition (Cartridge; 30-06, 30-30, .22 caliber, .50 Caliber, 9mm, and 12 gauge)		
A1	A1-171	3 lb Practice Bomb, AN-Mk 23	2	5	3 lb Practice Bomb, AN-Mk 5 (20 intact+frag)	490	0-24
	A1-179	3 lb Practice Bomb, AN-Mk 23	1	9	3 lb Practice Bomb, AN-Mk 23 (25 intact+frag)		
	A1-199	3 lb Practice Bomb, AN-Mk 23	1	18	4.5 lb Practice Bomb, AN-Mk 43 (frag)		
	A1-200	3 lb Practice Bomb, AN-Mk 5	1	6	13 lb Practice Bomb, AN-Mk 19 (1 intact+frag)		
	A1-207	3 lb Practice Bomb, AN-Mk 23	1	5	Unidentifiable Frag		
	A1-208	3 lb Practice Bomb, AN-Mk 5	1	4	Expended Small Arms Ammunition		
	A1-210	3 lb Practice Bomb, AN-Mk 5	1	1	Bomb Ejector Rack		
	A1-213	4.5 lb Practice Bomb, AN-Mk 43	4	1			
	A1-217	3 lb Practice Bomb, AN-Mk 23	1	18			

	MEC (in form of UXO)				MD		
	A1-222	3 lb Practice Bomb, AN-Mk 23	1	14			
	A1-135	3 lb Practice Bomb, AN-Mk 5	1	8			
	A1-138	13 lb Practice Bomb, AN-Mk 19	10	6			
	A1-141	3 lb Practice Bomb, AN-Mk 23	1	4			
	A1-145	13 lb Practice Bomb, AN-Mk 19	1	2			
	A1-163	3 lb Practice Bomb, AN-Mk 23	1	3			
	A1-164	3 lb Practice Bomb, AN-Mk 23	10	8			
	A1-167	3 lb Practice Bomb, AN-Mk 23	2	12			
	A1-121	4.5 lb Practice Bomb, AN-Mk 43	1	2			
	A1-074	3 lb Practice Bomb, AN-Mk 23	1	4			
	A1-039	3 lb Practice Bomb, AN-Mk 23	1	6			
	A1-068	3 lb Practice Bomb, AN-Mk 23	1	12			
	A1-005	3 lb Practice Bomb, AN-Mk 5	2	0			
	A1-006	3 lb Practice Bomb, AN-Mk 5	1	0			
	A1-010	3 lb Practice Bomb, AN-Mk 23	2	0			
	A1-012	13 lb Practice Bomb, AN-Mk 19/ 3 lb Practice Bomb, AN-Mk 23	4	0			
	A1-013	3 lb Practice Bomb, AN-Mk 23	3	0			
	A1-014	3 lb Practice Bomb, AN-Mk 5	1	0			
	A1-015	3 lb Practice Bomb, AN-Mk 5	1	0			
	A1-016	3 lb Practice Bomb, AN-Mk 23	2	0			
	A1-017	3 lb Practice Bomb, AN-Mk 5	1	0			
	A1-018	3 lb Practice Bomb, AN-Mk 5	1	0			
	A1-019	3 lb Practice Bomb, AN-Mk 5	1	0			
		TOTAL	**99**			**1,024**	

1-Intact MD items are fully expended and not UXO.

4.1.2 Source, Nature, and Extent of UXO

The source of UXO and MD encountered onsite was from munitions used during practice at the bomb and rocket range during from 1941 to 1946.

The nature and quantity of the items encountered during the 2013 RI are presented in Appendix J associated with the anomaly identifier where found. Coordinates of the anomaly identifier are provided in Appendix J in the Table of Intrusive Results. A total of 99 UXO items were encountered, and over 1,024 lb of MD was removed. The vertical extent (depth) of the items as shown on Table 4-1 ranged from surface (0 inches) to 18 inches bgs. Horizontal extent of items found are shown on Figure 4-1 which presents the items found by type (UXO or MD). Figure 4-1 shows the density distribution of items found. The MC sampling locations were established from the results presented on map.

To calculate the UXO/MD density the intrusive results are first analyzed and only UXO or MD items are selected to be processed. Cultural debris findings were not included. The intrusive results data was then run through the Density function inside Spatial Analyst, a module of ESRI's ArcGIS software. This Density function analyzes each point in the intrusive data, searches for other data points within a pre-determined radius and uses the values associated with those points to interpolate density contours for the entire area that was surveyed. The resulting density data can then have colors assigned to density ranges and can be displayed visually on a map. For this project, the data values used in the density module were the quantities of UXO/MD found at each data point, a search radius of 50 meters, and density units of acres.

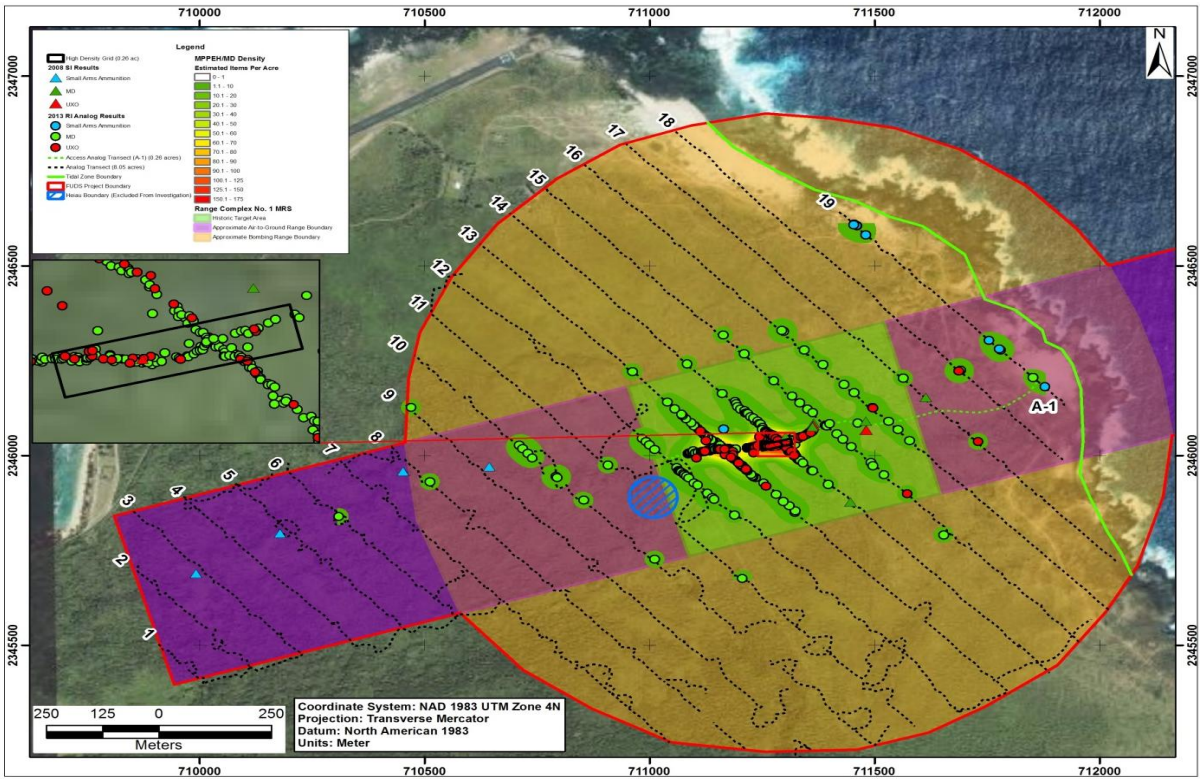

Figure 4-1: RI Intrusive Results and Density Map

4.1.3 MEC Exposure Pathways on Land

The site is located within the Kalaupapa National Historic Park, owned by the State of Hawaii and managed by the National Park Service, State of Hawaii DLNR, and HDOH. Receptors would include recreational users with a permit and escort.

It has been determined an explosive hazard is present on the land portion of the site. Exposure pathways for MEC (in the form of UXO) are complete if a recreational user or escort were to encounter, handle and detonate UXO on the surface. Intrusive activities are not anticipated due to the historical nature and lack of development at site.

4.1.4 Exposure Pathways in Tidal Water

The Project Team agreed not to investigate the water portions of the site due to the dangerous sea conditions caused by a rocky shoreline, constant high waves and strong tidal currents. Per the DQOs, the RI report is to evaluate the likelihood of an explosive hazard present in the water portions of the MRS, based on the land findings. The UXO findings during the investigation were concentrated near the target center. The closest UXO item was found approximately 850 feet from the land/sea interface. The closest MD items were found approximately 200 ft from the shoreline and were mainly in the form of small arms ammunition. The dangerous sea conditions would not attract recreational divers, and the exposure pathway is incomplete. Exposure pathways are considered incomplete in the tidal water since no receptors are likely to be in the area.

4.2 MUNITIONS CONSTITUENTS

This section describes the MC results obtained from the five DUs sampled during the RI field effort. Sample locations were determined by the results of the transect investigation findings. Sample locations are shown in Figure 4-2**Error! Reference source not found.**. A close up of the location of samples collected relative to UXO and MD findings is shown in Figure 4-3

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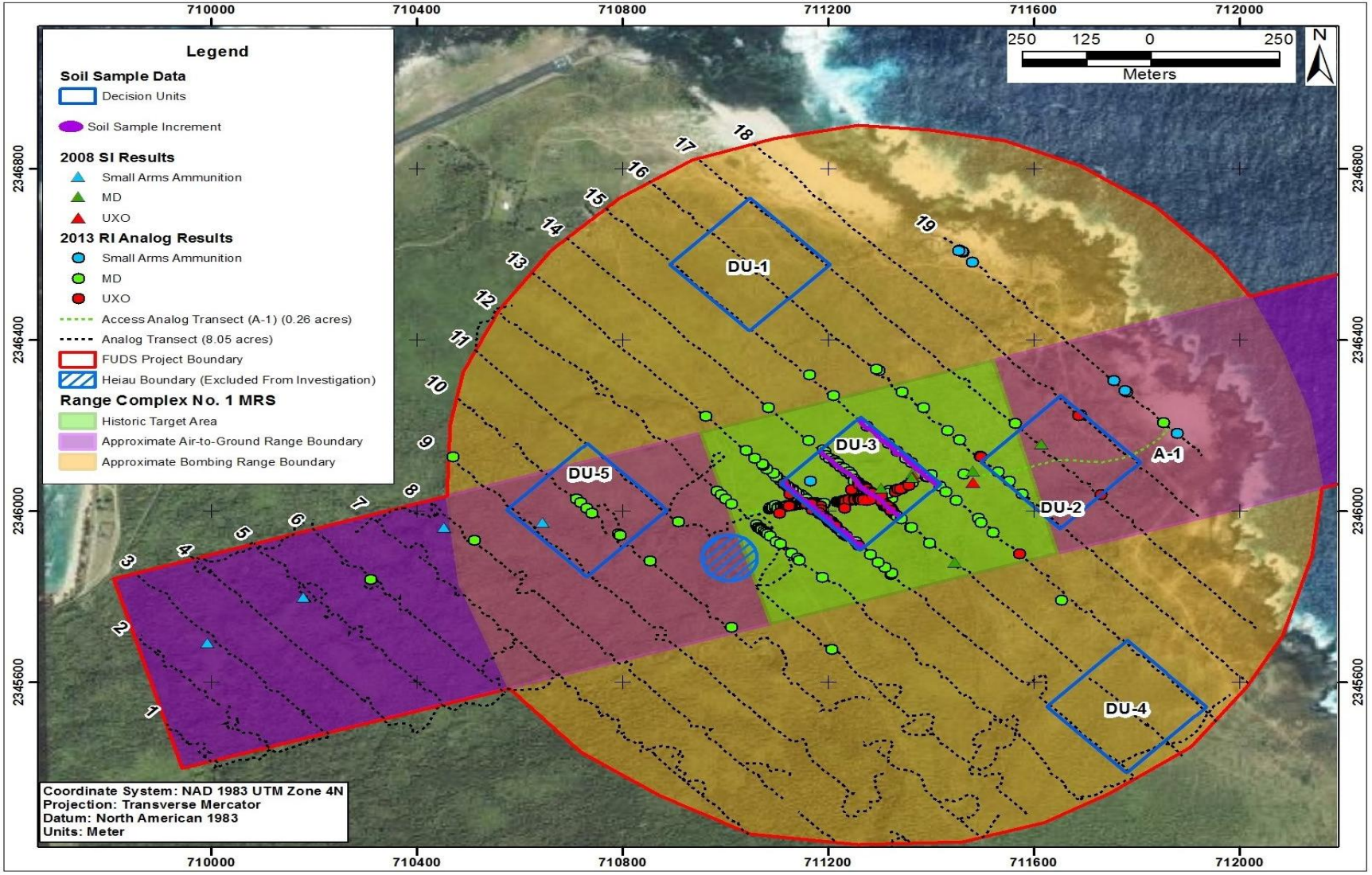

Figure 4-2: Sample Locations

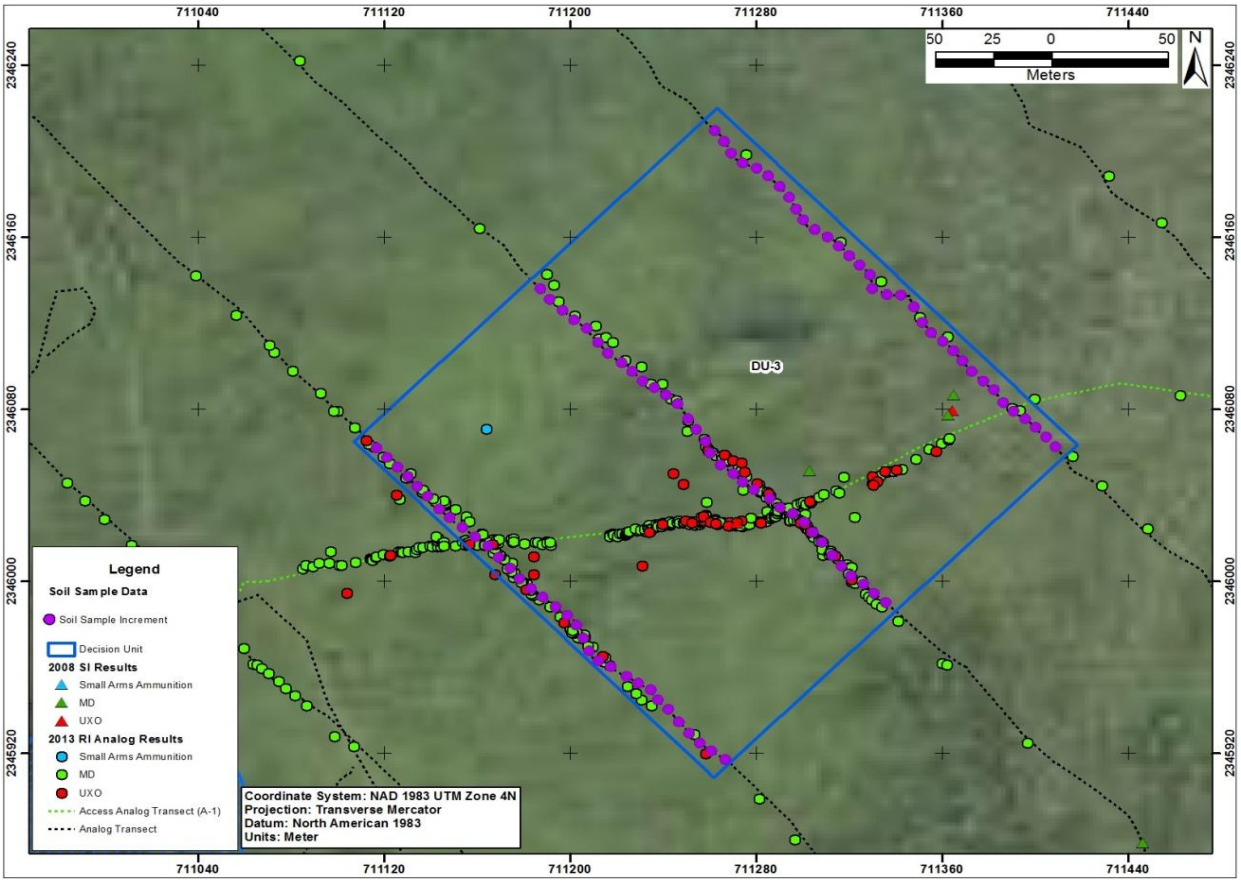

Figure 4-3: Decision Unit 3 Increment Locations

4.2.1 MC Results

No explosive compounds were detected above the laboratory's Limits of Detection (LODs) in any of the 13 surface soil increment samples collected from the five DUs established within the former MBR. Triplicate IS soil samples were collected from two of the three DUs (DU-2 and DU-3) established in areas where MEC and MD was observed within the MBR. A single IS soil sample was collected from one of the three DUs (DU-5) containing MEC and MD. Triplicate IS soil samples were also collected from the two "background" DUs (DU-1 and DU-4) established in areas within the MBR where MEC and MD were not observed.

Table 4-1 presents the analytical data for the metals and explosive compounds obtained in the six IS near-surface soil samples collected from the two "background" DUs in which MEC and MC were not observed. No explosive compounds were detected above the laboratory's LOD in any of these samples. However, three of the four metals were detected; antimony was not detected in any of these samples above the laboratory's LOD of 0.2 mg per kilogram (mg/kg). The lead concentration measured in the background samples ranged from 6.7 to 12 mg/kg, with a lead concentration maximum 95% Upper Confidence Limit (UCL) 14 mg/kg. The copper concentration measured in the increment samples ranged from 49 to 52 mg/kg, with a copper

concentration 95% UCL of 53 mg/kg. The zinc concentration measured in the background samples ranged from 110 to 150 mg/kg, with a zinc concentration 95% UCL of 162 mg/kg.

Table 4-2 presents the analytical data for the metals and explosive compounds obtained in the three DUs in which MEC and MC were observed. No explosive compounds were detected above the laboratory's LOD in any of these seven near-surface increment soil samples (two triplicates and one single sample).

The detected concentrations of lead, copper, and antimony were measured to be above the 95% UCL of the background concentrations in the triplicate samples collected from DU-3, which was centered over the portion of the site that was found to contain the highest amount of MEC and MD. All zinc concentrations were below both the maximum detected background analyte background concentrations and the maximum 95% UCL of the background DUs. The lead concentrations measured in triplicate DU-3 increment samples ranged from 57 to 110 mg/kg, with a 95% UCL of 126 mg/kg. The copper concentrations measured in the triplicate DU-3 increment samples ranged from 54 to 63 mg/kg, with a 95% UCL of 66 mg/kg. The zinc concentrations measured in the triplicate DU-3 increment samples ranged from 120 to 140 mg/kg, with a 95% UCL of 147. The 95% UCL of Lead and copper did not exceed Tier 1 EAL. The antimony concentrations measured in the triplicate DU-3 increment samples ranged from 0.43 to 2.1 mg/kg, with a 95% UCL of 2.61. The maximum onsite detected value for antimony (2.1 mg/kg) did not exceed the HDOH Tier 1 EAL (2.4 mg/kg), however, the 95% UCL (2.61 mg/kg) for antimony in DU 3 did slightly exceed the PAL.

The metals concentrations measured in DUs 2 and 5 which contained relatively minor amounts of MEC and MD were similar to the concentrations measured in the background samples. The copper concentration measured in DU-5 was slightly higher than the copper concentrations measured in the background samples collected from the former MBR, but well below the Tier 1 EAL of 626 mg/kg.

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Table 4-2: MBR Background MC Sample Results: Metals and Explosive Compounds in Soil (mg/kg)

Analyte	Tier 1 EAL[1]	Decision Unit 1				Decision Unit 4			
		MBR-01	MBR-02	MBR-03	95% UCL	MBR-10	MBR-11	MBR-12	95% UCL
		Metals/Inorganics (SW-846 6010B/6020) (mg/kg)							
Lead (Pb)	200	7.8	6.7	12	14	8.3	7.2	7.4	9
Copper (Cu)	626	50	49	49	50	52	49	51	53
Antimony (Sb)	2.4	U (< 0.20)	U (< 0.20)	U (< 0.20)	0.16	U (< 0.20)	U (< 0.20)	U (< 0.20)	0.16
Zinc (Zn)	1,000	150	110	110	162	120	120	120	120
		Explosives (SW-846 8330B) (mg/kg)							
2-Amino-4,6-dinitrotoluene	0.70	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
4-Amino-2,6-dinitrotoluene	0.70	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
3,5-Dinitroaniline	NS	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
1,3-Dinitrobenzene	1.2	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
2,4-Dinitrotoluene	1.6	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
2,6-Dinitrotoluene	4.3	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
HMX	29.1	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
Nitrobenzene	2.3	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
Nitroglycerin	1.2	U (< 0.25)	U (< 0.24)	U (< 0.25)	0.26	U (< 0.25)	U (< 0.25)	U (< 0.25)	0.25
4-Nitrotoluene	30.3	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
2-Nitrotoluene	1.9	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
3-Nitrotoluene	22.7	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
(pentaerythrite tetranitrate) PETN	24.4	U (< 0.25)	U (< 0.24)	U (< 0.25)	0.26	U (< 0.25)	U (< 0.25)	U (< 0.25)	0.25
(cyclotrimethylene trinitramine) RDX	2.8	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
Tetryl	48.9	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
1,3,5-Trinitrobenzene	8.4	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13
2,4,6-Trinitrotoluene	7.2	U (< 0.05)	U (< 0.048)	U (< 0.051)	0.13	U (< 0.049)	U (< 0.050)	U (< 0.049)	0.13

[1]*Tier 1 EAL = Unrestricted land use at sites where surface water is located within 150 meters of the release site and where the site is underlain by a non-drinking water resource (Table B-2, HDOH 2012).*

U = Undetected at the Limit of Detection (Value in Parenthesis).

Table 4-3: MBR MC Sample Results: Metals and Explosive Compounds in Soil (mg/kg), Decision Units 2, 3, and 5

Analyte	Tier 1 EAL[1]	Decision Unit 2			Decision Unit 3			Decision Unit 5
		MBR-04	MBR-05	MBR-06	MBR-07	MBR-08	MBR-09	MBR-13
Metals/Inorganics (SW-846 6010B/6020) (mg/kg)								
Lead (Pb)	200	6.9	5.4	7.2	57	73	110	8.2
Copper (Cu)	626	44	47	45	56	54	63	62
Antimony (Sb)	2.4	U (< 0.20)	U (< 0.20)	U (< 0.20)	0.47	2.1	0.43	U (< 0.20)
Zinc (Zn)	1,000	110	130	120	120	130	140	130
Explosives (SW-846 8330B) (mg/kg)								
2-Amino-4,6-dinitrotoluene	0.70	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
4-Amino-2,6-dinitrotoluene	0.70	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
3,5-Dinitroaniline	NS	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
1,3-Dinitrobenzene	1.2	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
2,4-Dinitrotoluene	1.6	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
2,6-Dinitrotoluene	4.3	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
HMX	29.1	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
Nitrobenzene	2.3	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
Nitroglycerin	1.2	U (< 0.24)	U (< 0.24)	U (< 0.23)	U (< 0.25)	U (< 0.23)	U (< 0.24)	U (< 0.25)
4-Nitrotoluene	30.3	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
2-Nitrotoluene	1.9	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
3-Nitrotoluene	22.7	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
(pentaerythrite tetranitrate) PETN	24.4	U (< 0.24)	U (< 0.24)	U (< 0.23)	U (< 0.25)	U (< 0.23)	U (< 0.24)	U (< 0.25)
(cyclotrimethylene trinitramine) RDX	2.8	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
Tetryl	48.9	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
1,3,5-Trinitrobenzene	8.4	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)
2,4,6-Trinitrotoluene	7.2	U (< 0.049)	U (< 0.048)	U (< 0.046)	U (< 0.05)	U (< 0.047)	U (< 0.048)	U (< 0.049)

[1]Tier 1 EAL = Unrestricted land use at sites where surface water is located within 150 meters of the release site and where the site is underlain by a non-drinking water resource (Table B-2, HDOH 2012).
U = Undetected at the Limit of Detection (Value in Parenthesis).

The maximum detected value and the 95% UCL of the metals measured in the DUs containing MEC and MD are compared with the maximum detected value and the 95% UCL of concentrations measured in the background DUs in Table 4-4. The shaded values in the table highlight concentrations in the DUs that exceed background concentrations. The former use of the site as a bombing range has resulted in slightly higher concentration levels of lead, copper and antimony in near-surface soils in DU-3 and slightly higher concentration levels of copper in DU-5. The the 95% UCL of antimony slightly exceeded the PAL, despite all three increment samples collected from DU-3 containing antimony concentrations below the PAL of 2.4 mg/kg.

Table 4-4: Maximum Detected Metals Sample Results and 95% Upper Confidence Limit for Triplicate Samples (mg/kg)

Analyte	Tier 1 EAL[1]	Background		Decision Unit 3		Decision Unit 2		Decision Unit 5 [3]
		Max	95% UCL[(1)]	Max	95% UCL	Max	95% UCL	Value
Lead (Pb)	200	12	14	110	126	7.2	8	8.2
Copper (Cu)	626	52	53	63	66	45	48	62
Antimony (Sb)	2.4	U (< 0.20)	0.16	2.1	2.61	U (< 0.20)	0.16	U (< 0.20)
Zinc (Zn)	1,000	150	162	140	147	120	137	130

1. Background values are determined from the concentrations measured in the six IS samples collected from DU 1 and DU 4 from areas where no MEC or MD were present. The maximum 95% UCL of the two background DUs was used for comparison.
2. Yellow shaded cells indicate Metals Concentrations were Above the Range of Metals Concentrations Measured in the Background Samples. Orange shaded cell indicates 95% UCL exceeded Tier 1 EAL.
3. DU 5 was not sampled in triplicate, therefore a 95% UCL was not calculated.

4.2.2 Source Blank and Equipment Rinseate Results

A source water sample and equipment rinseate sample were collected during the field sampling work. The purpose of this sampling was to verify that the pre-cleaned sampling equipment did not contain any residual contamination. The equipment rinseate sample was collected by pouring the source water over an unused PVC sampling cap that was positioned above the sample jar. No metals or explosive compounds were detected in the equipment rinseate or source blank samples collected during this investigation.

4.2.3 Review of Analytical Data

The following QA/QC checks were employed during the collection of field data and sampling activities.

- Collection of samples and field measurements by qualified personnel. Element personnel engaged in environmental investigations have extensive experience in site characterization work, and are familiar with federal, state, and local requirements, as well as with industry protocols concerning equipment decontamination, sample collection, sample and project documentation, and QC procedures.
- Use of new, clean, and dedicated sampling devices and sample bags.

- Preservation of sample integrity by chilling samples in the field and maintaining proper temperature until receipt at the laboratory.

4.2.3.1 TestAmerica Results

TestAmerica Laboratories, Inc. (Sacramento, California) received one shipment of 13 increment soil samples for analysis on April 5, 2013 [Sample Delivery Groups (SDGs) 320-2217-1 for soil samples and 320-2217-2 for water samples]. Samples were received intact and in good condition, cold (1.6°C), and consistent with the accompanying COC form. All samples were stored in a refrigerator at 4°C upon receipt at the laboratory. The Level 2 laboratory reports for the two SDGs are included in Appendices J.2.1 and J.2.2.

4.2.3.2 LDC Review

The Data Usability Report prepared by LDC is appended to the report. As part of the QC for this project, Element subcontracted Laboratory Data Consultants, Inc. (LDC) to complete an EPA Level III & IV review of the data package received from TestAmerica. This effort included a review of the hold times, blank spike recoveries, surrogate recoveries, relative percent differences, and sample triplicates. The EPA Level IV review was performed on samples MBR-01 and -04 (at least 10 percent of all data results). Results are provided in LDC Data Validation Report 29797 (Appendix I.3). The following lists report the completion of requirements for EPA methods Explosives (EPA SW8330B) and Metals (EPA 6010B/6020).

Explosives (EPA SW8330B)

- Both extraction and analysis holding times were met.
- The %RSD for the initial calibration for RDX was 16.0%, just outside the control limit of 15%. All associated data for all samples in the SDG were flagged as estimated with a "J" if detected and "UJ" if non-detect (ND).
- Tetryl was detected in a method blank at a level above the method detection limit (MDL), but below the reporting limit (RL). The value should be considered an estimate (flagged J).
- All surrogate recoveries except for one sample was within QC limits. 3, 4-Dinitrotoluene in sample MBR-09 had a %R of 116, just outside limits of 75-115%. All Target Compound List (TCL) compound detects were qualified as estimated with a "J."
- All MS/MSD recoveries were within QC limits.
- All laboratory Control Spike (LCS) recoveries met QC acceptance criteria.

Metals (EPA 6010B/6020)

- Both extraction and analysis holding times were met.
- Copper was detected in method blanks at levels above the MDL, but below the RL. The values should be considered an estimate (flagged "J").
- The MS recovery was outside of the control limits for antimony. The MSD recovery was outside of the control limits for lead and antimony. All associated data for all samples in

the SDG were qualified as estimated with a "J" if detected and "UJ" if ND. All LCS recoveries met QC acceptance criteria.

- The %RSD limit for Antimony for DU-3 triplicate set (samples MBR-07, -08, and -09) was calculated to be 95%, which was outside the control limit of 35%. Results were 0.47, 2.1, and 0.43 mg/kg, respectively.

4.2.3.3 Evaluation of Replicate Increment Soil Samples

Triplicate samples were collected from four of the five DUs (DU-1 through DU-4) in order to evaluate the field sampling, laboratory sub-sampling, and analytical precision. Field replicate samples, like all project samples, were assigned unique ID numbers so that the sample could not be identified by the laboratory as a field replicate. Replicate samples were analyzed for the same parameters as regular project samples.

The RSDs of the triplicate soil samples were calculated to assess the precision of the analytical results obtained from the increment sampling. The RSD indicates how precisely the three replicates measure from the average value and the RSD describes the ratio of the standard deviation to the average concentration of the contaminant(s) detected in the DU (expressed as a percent). The lower the RSD, also called the "coefficient of variation," the more precise the replicates are as an estimate of the average contaminant concentration in the DU under investigation.

The RSD values obtained for each analyte within each DU are summarized in a series of tables included in Appendix I.4. For this project, all RSDs were less than 30%, with one exception. The RSD value for Antimony (DU-3) was 95%; and antimony values ranged from 0.43 to 2.1 mg/kg, all below the Tier 1 EAL. Based on this criterion, there is limited variability observed in the triplicate samples collected. No other data discrepancies were noted between increment samples collected during the course of this project.

4.2.4 Source, Nature and Extent of MC Contamination

No evidence of explosives contamination was detected in any of the 13 increment samples collected from within the MBR. Slightly elevated levels of lead, copper, and antimony were measured in DU-3, which contained the highest amount of MEC and MD within the former MBR. Slightly elevated levels of copper were also detected in DU-5. None of the metals concentrations measured in the increment samples collected from the five DUs within the MBR exceeded their respective HDOH Tier 1 EALs.

4.3 DELINEATION OF MUNITIONS RESPONSE SITES

This section describes the process of delineating the Range Complex No. 1 MRS into two areas based on explosive hazard.

4.3.1 Background

The 2008 SI and the 2013 RI both determined an explosive hazard exists within the Range Complex No. 1 MRS. UXO items remaining from bombing and rocket training from 1941 to 1946 likely still remain onsite.

4.3.2 Delineated Munitions Response Sites

The revised target area was developed by using a combination of the intrusive results and MEC (UXO)/MD anomaly density that was generated. Using these two pieces of data, a boundary was drawn around the most heavily contaminated areas of the site that best represented as a target area.

The new boundaries are recommended based on level of potential explosive hazard present in each area determined by MEC (in the form of UXO) and MD findings/densities encountered during historical site visits and the 2013 RI. Table 1-1 and Table 4-1 list the historical and 2013 RI UXO findings onsite. No UXO and only very low densities of expended small arms ammunition have been found in the Remaining Lands area. Separating the MRS acreage into two areas allows each to be addressed in a cost-efficient and sensible manner appropriate to the level of explosive hazard present within each area.

No unacceptable risk to human or ecological receptors from MC contamination was identified within either area and therefore the risk is not a consideration in the re-delineation. Both areas have the same land use and are undeveloped.

Figure 4-4 shows the recommended re-delineated boundaries for Range Complex No. 1.

Based on the MEC anomaly map shown in Figure 4-1, it is not anticipated UXO are present within the tidal waters within the MRS. Therefore, the tidal waters are entirely included in the Remaining lands, and not included in the re-delineation of the target area of the MRS as shown on Figure 4-4.

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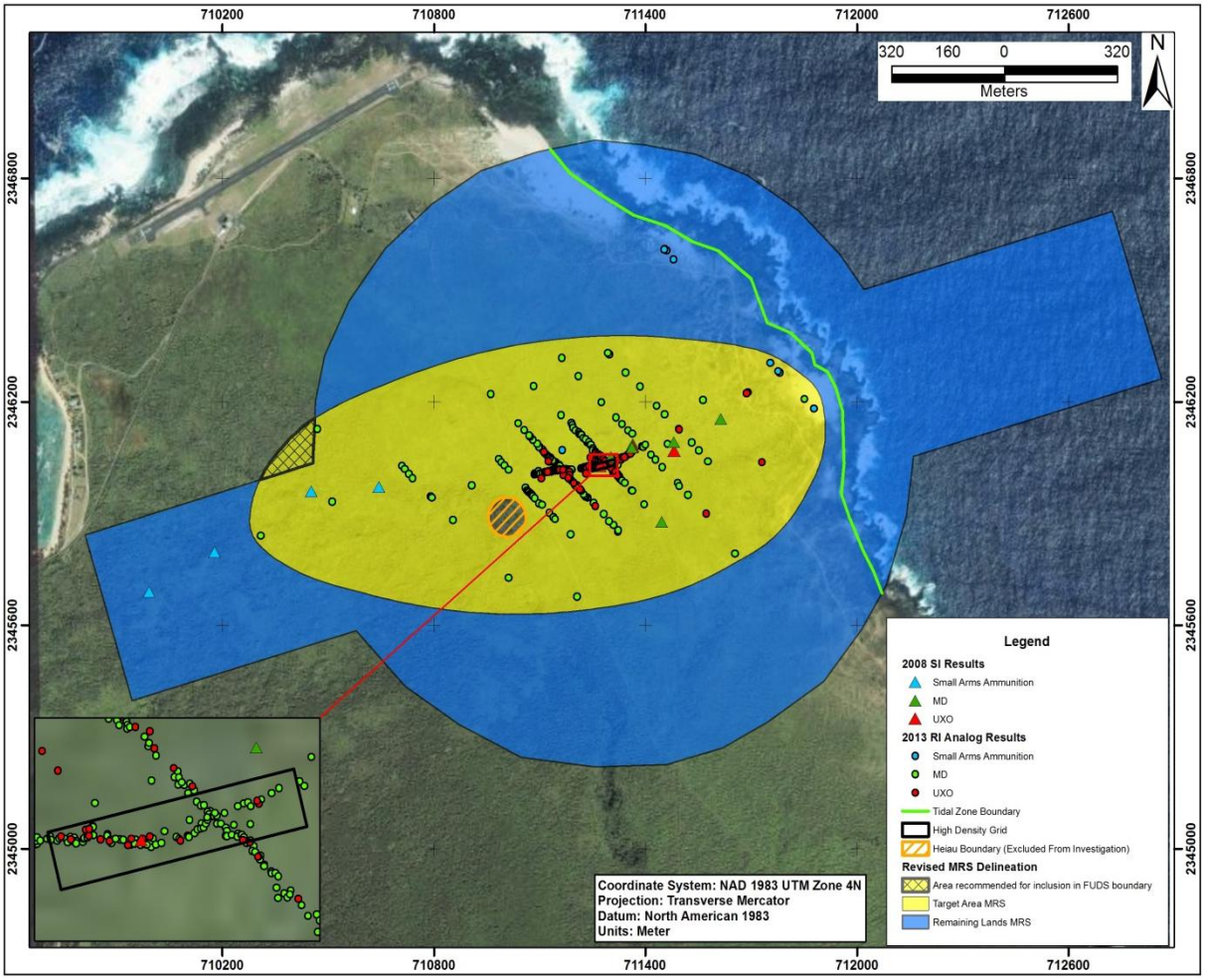

Figure 4-4: Recommended MRS Re-delineation

4.3.3 Revised Conceptual Site Models and Potentially Complete Exposure Pathways for Delineated Areas of Range Complex No. 1 MRS

The Preliminary MEC and MC CSMs presented in Chapter 2.0 have been updated to reflect the recommended split of Range Complex No. 1 into two areas, the Target Area and the Remaining Lands, based on the level of explosive hazard present within each area. The delineation is based on findings from the 2008 SI and 2013 RI fieldwork. The MEC CSMs are presented in table format and include both areas presented in the same table (Table 4-4). The MC CSM is prepared in flowchart format, and since neither the target area nor the remaining lands has an unacceptable risk to human or ecological receptors from MC, and both areas have the same receptors and site conditions, both areas are represented by the same MC CSM (Figure 4-5).

Table 4-5: Revised MEC Conceptual Site Model for Range Complex No. 1 MRS Target Area and Remaining Lands

Munitions Response Site Details	REVISED CONCEPTUAL SITE MODEL SUMMARY					REMEDIAL INVESTIGATION TECHNICAL APPROACH			
	Known or Suspected Contamination Source(s)	Potential/ Suspected Location and Distribution	Source or Exposure Medium	Current and Future Receptors	Potentially Complete Exposure Pathway	Investigation Method	Investigation Location(s)	Investigation Acreage/Number of Samples	Results
RANGE COMPLEX No. 1- **Target Area** Acreage [1]: 232.84 (land) Suspected Past DoD Activities (*release mechanisms*): Target Area for Bombing and Rocket Range Current and Future Land Use: Recreational	Land Area Practice Bombs (AN-Mk5, AN-Mk23, AN-Mk43, AN-Mk19) with signals; Small Arms Ammunition. The Target Area does not extend into the Tidal Water Area.	Significant evidence of MEC hazards remaining from UXO; Heavy concentration at target center	UXO items found surface and subsurface.	Park personnel and recreational users. Anticipated Recreational Use: hiking. No Intrusive activities are anticipated.	Yes, handling of surface or subsurface UXO	Physical inspection and intrusive investigation with hand-held analog metal detector. Intrusive investigation included 100% of all anomalies detected to depth of detection.	Transects across entire land portion of MRS at approximately 250-foot spacing; 4-foot wide swath, plus investigation of an access transect through the center of the MRS.	Survey and intrusive investigation of 5.51miles (2.67 acres) of transects.	The transect investigation identified a target center. The target was delineated by MPPEH findings and MEC density. Note: Per PDT concurrence, 100% of all anomalies encountered on the planned transects plus the investigation of the access transect was deemed sufficient investigation. The access transect nearest ran from transect 19, the transect nearest the shoreline, through and past the target center. No grids or radial transects were necessary.
RANGE COMPLEX No. 1 - **Remaining Lands** Acreage [1]: 322.87 (land) 160.30 (tidal water) Suspected Past DoD Activities (*release mechanisms*): Buffer Area for Bombing and Rocket Range	Land Area None. No UXO or MD was found during the 2008 SI. Only very low densities of expended small arms ammunition were found during the 2013 RI.	None. No UXO or MD was found during the 2008 SI. Only very low densities of expended small arms ammunition were found during the 2013 RI.	None	Park personnel and recreational users. Anticipated Recreational Use: hiking. No Intrusive activities are anticipated.	No	Physical inspection and intrusive investigation with analog metal detector. 100% of all anomalies detected investigated to depth of detection.	Transects across entire land portions of MRS at approximately 250-foot spacing.	Survey and intrusive investigation of 11.63 miles (5.64 acres) of transects.	No MEC was found in this area. Only a few MD items found during the 2013 RI.
Current and Future Land Use: Recreational	Tidal Water Area None based on land investigation findings.	None based on land investigation findings.	None	None due to dangerous sea conditions.	No, consistent dangerous sea conditions consisting of rocky shoreline, large waves and strong currents not an area for diving.	Not investigated due to dangerous sea conditions.	N/A	N/A	UXO items were found 850 ft from land/ocean interface during 2013 RI, MD items mainly in the form of expended small arms ammunition were found closer. A rocky shoreline and constant high waves and strong current create conditions too dangerous to attract recreational divers or allow safe investigation in this area.
					Source: 1 – RI (2013)		DoD – Department of Defense MD – Munitions Debris MC – Munitions Constituents MEC – Munitions and Explosives of Concern MRS – Munitions Response Site		PDT – Project Development Team RI – Remedial Investigation

Note: Includes Heiau and 2.76 acres of the Target Area located outside the currently defined MRS boundary.

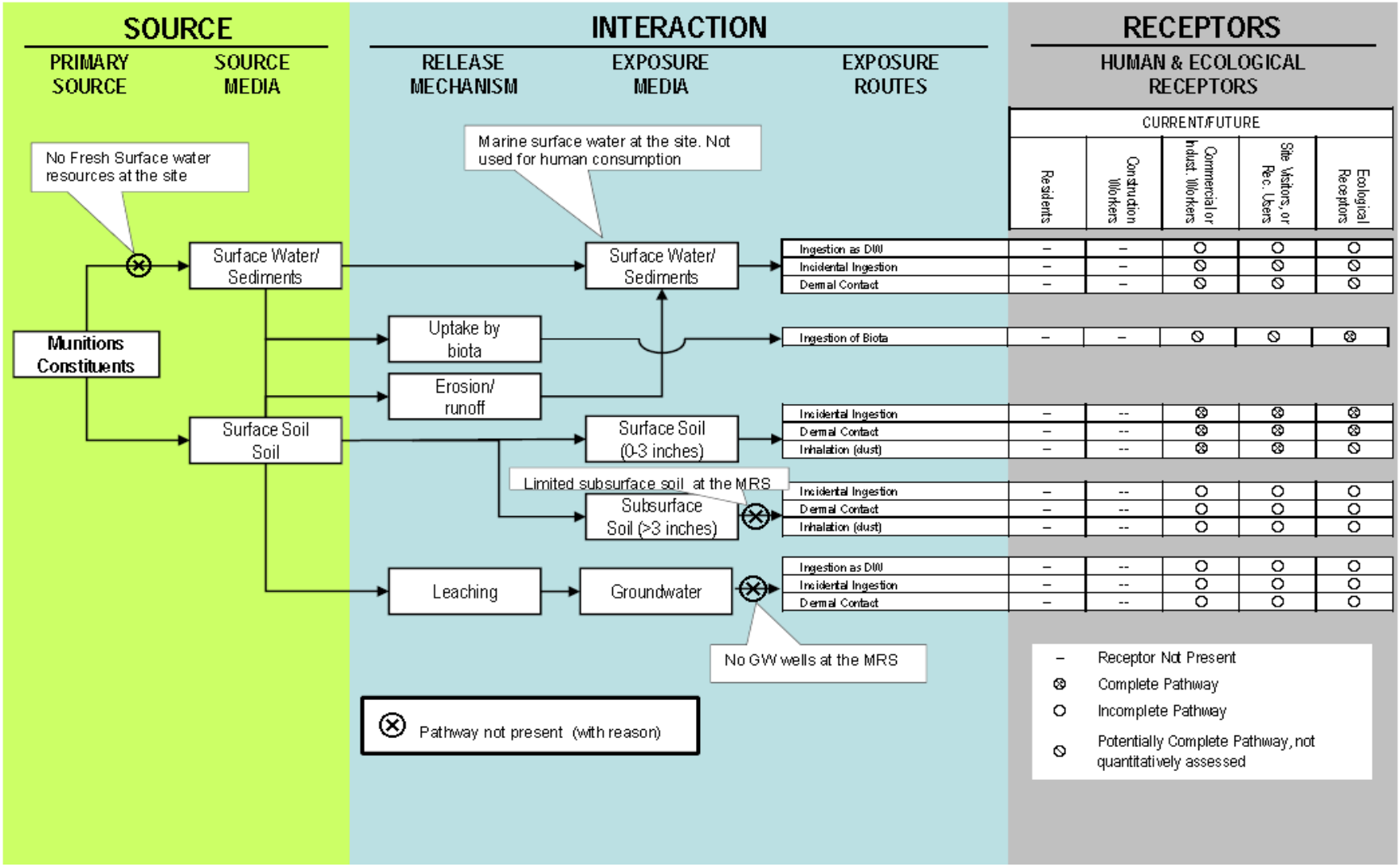

Figure 4-5: Revised MC Conceptual Site Model for MBR Range Complex No. 1

CHAPTER 5. CONTAMINANT FATE AND TRANSPORT FOR MEC/MC

This section describes the fate and transport of MEC and MC contaminants detected at the MBR.

5.1 FATE AND TRANSPORT FOR MEC

This section describes the fate and transport for MEC in the form of UXO present at the former MBR.

5.1.1 Potential Sources of Contamination

UXO present at the former MBR site would have originated from munitions that did not fully function during bombing, rocket, and strafing practice exercises fired toward the target located at the center of the site. Sections 1.3 and 4.1.1 identify the potential UXO items present on site to include practice bombs with signals, rockets, and projectiles.

5.1.2 Contaminant Persistence

Due to the metallic nature of the UXO items present onsite, they may remain intact in the environment for many years.

5.1.3 Contaminant Migration

The migration of UXO items can occur by natural processes or by the result of human activity. Natural processes usually involve erosion over time by the wind or water (strong storm and surf action) which can expose buried UXO by the removal of overlying soil and sand. In some cases, if soil is unstable and the erosive force is sufficient, this process can also result in the movement of UXO from its original position to another location. The proximity of the MBR to the Pacific Ocean makes the site susceptible to soil and beach erosion from tropical storm activity.

In addition to erosion, buried objects have been known to migrate toward the surface during freezing and thawing cycles in a process known as frost heave. Due to the tropical climate of Hawaii, frost heave is not anticipated at the site.

Human activities at MBR that could affect the transport of MEC items would involve visitors picking up items potentially as a souvenir.

5.2 FATE AND TRANSPORT OF MUNITIONS CONSTITUENTS CONTAMINATION

5.2.1 MUNITIONS CONSTITUENTS CONTAMINATION

The following sections describe the type and source of MC contamination that may potentially be present within the MBR.

5.2.2 Potential Sources of MC Contamination

The historic bombing exercises conducted at the MBR could potentially have released MC COPCs into the soils at the former MBR.

5.2.3 Primary Contaminant Media

Surface soil is the primary contaminant medium in the onshore portions of the former MBR site. However, only a thin veneer of soil (typically 3 in. thick or less) exists atop the fresh ʻaʻā and pāhoehoe lava flows that erupted from Kauhako Crater to produce the Kalaupapa Peninsula. The thin layer of soil present at the site is composed of rocky, reddish-brown, silty clay.

5.2.4 Primary Transport Mechanism

The primary transport mechanism for MC in the shallow surface soils at the former MBR site is airborne dust, due to the fine-grained nature of the silty clay at the site.

5.2.5 Secondary Contaminant Media

Groundwater can potentially serve as a contaminant transport mechanism that may affect nearby surface water bodies, drinking water supplies, vegetation, and sensitive environments. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported to the groundwater, site-specific geology, climate, and the expected future land use.

Surface water can serve as a contaminant transport mechanism that may affect surface water bodies, sediment, soil, drinking water supplies, vegetation, and sensitive environments such as tide pools. The likelihood of exposure is influenced by such factors as the volume and concentration of contaminated soil at the ground surface that can be transported via surface water or suspended sediment through runoff.

For the former MBR site, the primary releases of MC during historic munitions activities would be to surface soil. MC could then be potentially transported to nearby surface water bodies (i.e. the Pacific Ocean) through runoff. However, there is little surface soil at the site and no fresh water bodies or tide pools located down-slope and down-wind of the former MBR site.

5.3 POTENTIAL HUMAN RECEPTORS AND EXPOSURE PATHWAYS

The former MBR site is located within the Kalaupapa National Historic Park, owned by the State of Hawaii and managed by the National Park Service (NPS), State of Hawaii DLNR, and HDOH. It is a significant historical and archaeological place and no future development of the site is planned. A total of 26 inhabited structures are located within 2 miles of the project boundary, most within the Kalaupapa Settlement. The current population of the settlement is around 100 individuals while the NPS reports that a total of 58,875 visitors visited the National Historic Park in 2012. The former MBR is not located in a portion of Kalaupapa Peninsula that is typically visited by visitors to the National Park.

The soil exposure pathway accounts for the primary potential risk to human receptors at the former MBR that may come into contact with impacted soil. Based on the current and future land use of the site, potential receptors include residents of the settlement, site visitors or recreational users through dermal contact, incidental ingestion, and inhalation of re-suspended particulate matter from the near surface soils present at the site.

5.3.1 Surface Soil

The former MBR site is covered by a thin (typically 0 to 3 in. thick) layer of silty clay near-surface soil that rests atop relatively fresh ʻaʻā and pāhoehoe basaltic lava that originated from Kauhako Crater. MC may be present in areas covered by these shallow surface soils as a result of the past disintegration of munitions over the past 70 years. Potentially complete human exposure pathways to MC in surface soil at the former MBR include ingestion, dermal contact, and inhalation of particulates.

5.3.2 Groundwater

The groundwater beneath the portion of Kalaupapa Peninsula on which the former MBR is located is brackish and not currently used for potable purposes. A freshwater production well was installed by the NPS in the 1980's at the head of the Waihanau Valley located southeast of the MBR, which provides freshwater for the Kalaupapa Settlement (CEPOH, 1991). However, this well is hydraulically up-gradient of the Project Site and the potable water tapped by this well was not impacted by bombing operations at the former MBR. As a result, there is no complete human exposure pathway to MC in the groundwater that underlies the site.

5.3.3 Surface Water

A stream located in Waikolu Valley immediately east of Waihanau Valley was the former source of water for Kalaupapa prior to installation of the NPS freshwater production well. This stream was not impacted by bombing activities at the former MBR site. No intermittent or perennial streams run across the former MBR due to the overall flat topography of the site and the relatively high permeability of the lava flow units that underlie the shallow soil at the site. As a result, the surface water exposure pathway at the former MBR site is incomplete.

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CHAPTER 6. BASELINE HAZARD ASSESSMENT FOR MEC AND RISK ASSESSMENT FOR MC

The explosive hazard posed by MEC present at the former MBR site was evaluated by performing a baseline MEC HA on both the target area and the remaining lands. The two areas were divided by presence of UXO and MD density as described in Chapter 4.0. The Munitions Response Site Prioritization Protocol (MRSPP) prepared for the 2008 SI was updated to reflect the recommended re-delineation of the MRS.

The MEC HA and MRSPP serve distinct purposes in the management of MRSs. The purpose of the MRSPP is to prioritize MRS response actions on a national level. The purpose of the MEC HA is to assist in the evaluation and selection of remedial alternatives, including the implementation of LUCs, during the RI/FS stage of remedial actions. The MEC HA in this report only addresses baseline conditions. Remedial alternatives will be addressed in the recommended FS for the Target Area.

6.1 MUNITIONS RESPONSE SITE PRIORITIZATION PROTOCOL

In 2001, Congress directed that the DoD identify and then prioritize their MRSs. The protocol was published as a rule on 5 October 2005 (35 CFR Part 179). The protocol was designed to: 1) maximize use of the latest MRS-specific data, and 2) be applied early in the munitions response process. The protocol assigns a relative priority to each location in the DoD's inventory of defense sites known or suspected of containing UXO, DMM, or MC, and prescribes procedures for prioritizing the defense sites and general component responsibilities.

The site priority ranking is based on the risk posed by potential hazards captured in data entered for three hazard evaluation modules of the MRSPP: explosive hazard evaluation (EHE) module, chemical warfare materiel (CWM) hazard evaluation (CHE) module, and the health hazard evaluation (HHE) module. Separate MRSPP tables (EHE Tables 1 through 10, CHE Tables 11 and 20, HHE Tables 21 through 28, MRS Priority Table 29, and MRS Background Information Table A) were completed for the recommended re-delineated Target Area and Remaining Lands of Range Complex No. 1 MRS. These MRSPP tables can be found in Appendix G, Munitions Response Site Prioritization Protocol Score Sheets.

MRS priorities range from 1 (highest priority) to 8 (lowest priority). A score of 1 can only be assigned to a CWM site. Alternative module scoring may include qualitative responses, such as evaluation pending, no longer required, or no known or suspected hazard (explosive, CWM, and/or MC) hazard, instead of numerical scoring. The results of the MRSPP for the two recommended re-delineated areas of the MRS are presented in Table 6-1.

Table 6-1: Results of MRSPP

MRS	Acreage	EHE Module Rating	CHE Module Rating	HHE Module Rating	MRS Priority Rating
Range Complex No. 1 - Target Area	232.84[(1)] (land, Heiau included)	5	No Known or Suspected CHE Hazard	No Known or Suspected MC Hazard	5
Range Complex No. 1-Remaining Lands	483.17 (322.87 land, and 160.30 tidal water)	No Known or Suspected Explosive Hazard	No Known or Suspected CWM Hazard	No Known or Suspected MC Hazard	No Known or Suspected Hazard

(1) The target area extends 2.76 acres outside the FUDS property boundary, the area is recommended for future inclusion and included here.

6.2 BASELINE MEC HAZARD ASSESSMENT

A baseline MEC Hazard Assessments (MEC HA) was performed for the recommended re-delineated target area of the Range Complex No. 1 MRS. As described in Chapter 4.0, Range Complex No. 1 MRS was recommended for re-delineation into a Target Area and Remaining Lands based on level of potential explosive hazard identified through historical data and RI field activities. The Range Complex No. 1 - Target Area is the subject of this MEC HA and is referred to as the assessment area. Range Complex No. 1 – Remaining Lands is not evaluated by a MEC HA since only very small densities of expended small arms ammunition have been found in the area, and no explosive hazard is anticipated.

The MEC HA in this RI report establishes the baseline MEC HA for the target area using historical data and 2013 RI field findings. If recommended for a FS, the MEC HA will then evaluate potential alternatives to assist in evaluation of a remedial design.

The MEC HA qualitatively addresses the explosive hazards associated with MEC, i.e., the likelihood that MEC might detonate and potentially cause harm as a result of human activities. The MEC HA was designed to be used as the CERCLA hazard assessment methodology for a MRS where there is an explosive hazard from the known or suspected presence of MEC (EPA, 2008). An explosive hazard exists at a site if there is a potentially complete MEC exposure pathway. A potentially complete MEC exposure pathway is present any time a receptor can come near or into contact with MEC and interact with the item in a manner that might result in its detonation.

There are three elements of a potentially complete MEC exposure pathway: 1) a source of MEC, 2) a receptor, and 3) the potential for interaction between the MEC source and the receptor. All three of these elements must be present for a potentially complete MEC exposure pathway to exist.

6.2.1 MEC HA Input Factors

The MEC HA is structured around three components of potential explosive hazard incidents:

- Severity, which is the potential consequences (e.g., death, severe injury, property damage, etc.) of a MEC item detonating.
- Accessibility, which is the likelihood that a receptor will be able to come in contact with a MEC item.
- Sensitivity, which is the likelihood that a receptor will be able to interact with a MEC item such that it will detonate.

To complete the baseline MEC HA, various input factors are reviewed and suitable categories are selected based on historical documentation and field observations made during previous site visits and the 2013 RI field activities. These input factors include such details as energetic material type, site accessibility, potential receptor contact hours, amount of MEC, MEC classification, and MEC size, each of which has two or more possible categories. Each category for each of the MEC HA input factors has an assigned score that relates to the relative contributions of the different input factors to the overall MEC hazard. Scores for the categories are in multiples of five, with a total maximum possible score for all factors of 1,000 and a minimum possible score of 125. These MEC HA scores are qualitative references only and should not be interpreted as quantitative measures of explosive hazard. The various input factors for the MEC HA method are explained in detail in the MEC HA interim guidance document (USEPA, 2008) and are summarized below.

Table 6-2 associates the MEC HA input factors with the corresponding Explosive Hazard Components.

6.2.1.1 Energetic Material Type

This factor describes the general type of energetic material associated with the munition(s) known or suspected to be present within the assessment area. The six possible categories for this factor, ranging from the most to least potentially hazardous, are "high explosives and low explosive fillers in fragmenting rounds," "white phosphorus," "pyrotechnics," "propellants," "spotting charges," and "incendiaries." The selection of a category for each MRS or assessment area is made using the energetic material with the greatest potential explosive hazard known or suspected to be present.

The MEC items known or suspected to be present within the Range Complex No. 1-Target Area based on 2013 RI findings include a variety of practice bombs. The low explosive filler in the AN MK4 signal for the practice bombs is the most explosively configured munition known to be present onsite. Based on this item the energetic filler type is assessed to be "high explosives and low explosive filler in fragmenting rounds."

6.2.1.2 Location of Additional Human Receptors

It is possible that human receptors other than the individual who causes a detonation may be exposed to overpressure and/or fragmentation hazards from the detonation of MEC. This factor describes whether there are additional human receptors located within the assessment area or within the explosive safety quantity distance (ESQD) arc surrounding the assessment area. The

two possible categories for this factor are "inside the MRS or inside the ESQD arc surrounding the MRS" and "outside the ESQD arc."

The 3-in. AP Mk 29 projectile is the most hazardous of the explosively configured munitions known or suspected to be present in the MRS. The ESQD for the assessment area is 114 ft and is based on the hazardous fragment distance (HFD) of the projectile. There are no residences or areas where people would congregate within the EQSD arc. Based on this information, the location of additional human receptors is assessed to be "outside the ESQD arc" for the Target Area.

6.2.1.3 Site Accessibility

The site accessibility factor describes how easily human receptors can gain access to the assessment area and takes into account the various barriers to entry that might be present. The four possible categories of site accessibility range from "full accessibility" (i.e., a site with no barriers to entry) to "very limited accessibility" (i.e., a site with guarded chain link fences or terrain that requires special skills and equipment to access). Note that this factor differs from the potential contact hours factor (see below) and also does not include or account for LUCs that might restrict site access. The effects of LUCs are assessed using the alternatives assessment component of the MEC HA that is conducted during the FS.

Access is restricted; however visitors can access the entire area with a permit from the HDOH and NPS with an escort. The site accessibility is assessed as "full accessibility" for the entire site.

6.2.1.4 Potential Contact Hours

This factor accounts for the amount of time receptors spend in the area during which they might come into contact with MEC and intentionally or unintentionally cause a detonation. Both the number of receptors and the amount of time each receptor spends in the assessment area are used to calculate the total "receptor-hours/year." This total is calculated for all activities that might result in potential MEC interaction, and there are four possible categories, ranging from "many hours" (≥ 1,000,000 receptor-hours/year) to "very few hours" (< 10,000 receptor-hours/year).

The site is undeveloped with no plans for future development. It is located within the Kalaupapa National Historical Park. Access is restricted; however visitors can access the entire area via permit from the HDOH and NPS with an escort.

The estimation of contact hours assumes that 52 visits will be made per year by 7 people (6 people per visit plus escort) for 6 hours. Total contact hours are estimated to be 2,184 hours (52 trips x 7 people x 6 hrs). The number of contact hours estimated corresponds to a classification of "very few hours" (< 10,000 receptor-hours/year).

6.2.1.5 Amount of MEC

This input factor describes the relative quantity of MEC that is anticipated to remain within the assessment area as a result of past munitions-related activities. For example, a greater quantity of MEC would be expected to be present in a former target area than at a former firing point. The

nine possible categories for this factor, from the largest to the least anticipated amount of MEC, range from "target area" and "OB/OD area," through "burial pit" and "firing point," to "storage" and "explosives-related industrial facility."

The category selected for the areas with MEC findings and high densities of MD based on the 2013 RI is assessed to be "target area."

6.2.1.6 Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth

This factor indicates whether the MEC in the assessment area are at depths that might be reached by the anticipated human receptor activities. For the baseline MEC HA, the four possible categories concern whether MEC are at the surface and in the subsurface within the MRS or assessment area, or whether MEC are present in the subsurface only, and whether the receptor intrusive depth overlaps with this MEC location.

The minimum MEC depth based on RI findings is on the surface or 0 inches, and MEC was discovered in the subsurface to a depth of 18 inches. The Maximum Receptor Intrusive depth is anticipated to be surface or 0 in. The archaeological significance of the site limits future development, and recreational use of the site would not involve intrusive activities. Therefore the input factor for this category is "MEC located on surface and in subsurface: intrusive depth overlaps with minimum MEC depth."

6.2.1.7 Migration Potential

The migration potential factor addresses the likelihood that MEC in the assessment area might be moved by natural processes (e.g., erosion or frost heave) that could increase the chance of subsequent exposure to potential human receptors. The two possible categories for this factor are "possible" and "unlikely."

The close proximity of the former MBR to the Pacific Ocean makes the site susceptible to soil and beach erosion from storm activity. Human activities at MBR that could affect the transport of MEC items would involve visitors picking up items to potentially take as a souvenir. Based on this information, the Migration Potential for the site is considered to be "possible."

6.2.1.8 MEC Classification

This factor accounts for how easily a human receptor might cause a detonation of the MEC and relates directly to the MEC sensitivity. The six possible categories for this factor, ranging from the highest to lowest sensitivity (and explosive hazard) are "sensitive unexploded ordnance [UXO]," "other UXO," fuzed sensitive DMM," "fuzed DMM," "unfuzed DMM," and "bulk explosives." The selection of category is made using the MEC with the highest potential sensitivity known or suspected to be present, and where uncertainty exists, conservative assumptions will be made and documented. For example, UXO is always assumed to be present within a known target area, even if the investigation uncovers no UXO at the site.

Based on the low explosive filler in the AN MK4 signal for the practice bombs found onsite (identified in the 2013 RI Investigation) the category is "other UXO."

6.2.1.9 MEC Size

This factor indicates how easy it is for a typical human receptor to move the MEC item(s) present within the assessment area. For example, an individual is considerably more likely to pick up or accidentally kick a hand grenade than a 200-lb bomb. The basic assumption used in this category is that MEC items weighing 90 lb or more are unlikely to be moved without the use of special equipment. Based on this, the two possible categories for this factor are "small" (i.e., items weighing less than 90 lb) and "large" (items weighing 90 lb or more). The selection of category is made using the MEC known or suspected to be present with the highest potential to be moved (i.e., the smallest item).

Based on the the 3-lb (AN-MK23 and AN-MK 5) practice bombs found on site, the selection of this category is "small."

Table 6-2 summarizes the categories assessed for MEC HA input factors for the Range Complex No. 1 MRS – Target Area. The corresponding score for each category chosen is reported. For reference, the value in parentheses is the maximum possible MEC HA score for the category.

Table 6-2: Summary of Baseline MEC HA Scores for, Range Complex No. 1 – Target Area

Explosive Hazard Component	Input Factors	Category	Score
Severity	Energetic Material Type	High explosives and low explosive filler in fragmenting rounds.	**100** (100)
	Location of Additional Human Receptors	Outside of the EQSD Arc	**0** (30)
Accessibility	Site Accessibility	Full accessibility	**80** (80)
	Total Contact Hours	Very few hours (< 10,000 receptor-hours/year)	15 (120)
	Amount of MEC	Target Area	**180** (180)
	Minimum MEC Depth vs. Maximum Intrusive Depth	MEC located on surface and in subsurface	**240** (240)
	Migration Potential	Possible	**30** (30)
Sensitivity	MEC Classification	Other UXO	**110** (180)
	MEC Size	Small	**40** (40)
Total MEC HA Score			**795** (1,000)
MEC HA Hazard Level			**2**

Note: The value in parentheses is the maximum possible MEC HA score for the category.

CHAPTER 7. BASELINE RISK ASSESSMENT FOR MC

The following sections present an abbreviated baseline risk assessment for MC at the former MBR Site.

7.1 CONCEPTUAL SITE EXPOSURE MODEL

The project Work Plan presented a Conceptual Site Model (CSM) for the former MBR site, which is summarized in the following paragraphs (E2, 2012). There are currently no restrictions to access to the former MBR site. Current and future human receptors at the former MBR site consist of occupational workers (i.e., NPS workers), site visitors and the residents of Kalaupapa Settlement. The three complete human health exposure pathways include: 1) inhalation of chemical residuals adsorbed to airborne soil particulates; and 2) incidental ingestion and 3) dermal contact with chemical residuals in surface soil at the site. Although inhalation, ingestion, and dermal absorption are potential exposure pathways for human receptors, none of the three is considered significant due to minimal use of the site, and the low levels of MC metals detected. In addition, no explosives were detected onsite. The MC CSM for the former MBR site is shown in Figure 2-1.

Surface soil at the former MBR site is the primary exposure medium for ecological receptors. Plants may be exposed to COPCs through direct root contact with the accessible soil. Herbivores and omnivores can be exposed to bio-accumulative COPCs through the consumption of contaminated plant material. These COPCs can be further transferred up the food chain by successive consumption by predators (insectivores and carnivores). Ground-foraging species can be directly exposed to COPCs in the surface soil through incidental soil ingestion. Because of the near-absence and ephemeral nature of surface runoff at the site, exposure of ecological receptors to sediments and surface water is considered unlikely. Although inhalation and dermal absorption are potential exposure pathways for wildlife, neither is considered significant with respect to the ingestion pathways.

7.2 AFFECTED MEDIA

Direct release of MC from munitions activities at the site would have been to surface soil. There are no permanent surface water features within the site. Therefore, migration of MC from surface soil to surface water or sediment is unlikely. It is also unlikely that significant amounts of MC from surface soil would leach to the non-potable groundwater that underlies the site, due to the limited thickness (i.e., typically less than 3 in. thick) and volume of soil present at the site.

A total of thirteen near-surface increment soil samples were collected from five DUs established within the former MBR site. Three of the DUs were established in areas where MEC and MD were encountered, while two of the DUs were established in surrounding "background" areas where no MEC or MD was encountered. No other media (groundwater, surface water, sediment, or air) were sampled at the site during the current investigation.

7.3 SCREENING VALUES

The screening levels adopted for the former MBR site are the HDOH Tier 1 EALs for soil where the potentially impacted groundwater is not a current or potential drinking water resource and a surface water body is located less than 150 m from the release site (HDOH 2011a).

7.4 MC RISK CHARACTERIZATION

The risk posed by the MC present in near-surface soils at the former MBR site was evaluated by comparing the 95% UCL of each analyte in the thirteen increment samples to the Tier 1 EAL screening levels. For a chemical to be considered as a possible health concern at the site, it would be necessary for the chemical to be present above the screening level. Table 7-1 compares the maximum concentration, and 95% UCL of metals detected and the highest LOD obtained for the explosive compounds (since no explosive compounds were detected) in the thirteen increment samples collected from the former MBR with the associated Tier 1 EAL for each analyte.

7.5 MC HUMAN HEALTH RISK CHARACTERIZATION

Thirteen increment samples were collected from the former MBR site during this investigation. Table 4-3 compared the metals concentrations measured in the DUs established in areas where UXO and MD were observed with the mean and range of concentrations of metals detected in two background DUs established at the former MBR site. Slightly elevated concentrations of lead, copper, and antimony were measured in the triplicate samples collected from DU-3, which was centered over the portion of the site that was found to contain the highest amount of MPPEH and MD. The metals concentrations measured in DUs 2 and 5, which contained relatively minor amounts of UXO and MD, were similar to the concentrations measured in the background samples, with the exception of a slightly higher concentration of copper measured in DU-5. Zinc was not detected above background values in any of the DUs. No explosives were detected.

The maximum concentration of analytes detected at the former MBR site compiled in Table 7-1 shows that none of the metal concentrations detected within the thirteen increment samples collected from the five DUs exceeded its associated HDOH Tier 1 EAL. The calculated 95% UCL for antimony slightly exceeded the Tier 1 EAL of 2.4 mg/kg in DU-3. However, none of the three increment samples collected from DU-3 contained antimony above the Tier 1 EAL of 2.4 mg/kg, which was established based upon the natural range of antimony found in Hawaiian soils (HDOH, 2011a). The LOD obtained on the increment samples for the explosive compounds were below their respective HDOH Tier 1 EALs for each explosive compound analyte. ***Based upon these results, there is no evidence explosive compounds are present; and exposure to MC metals, antimony, copper, lead and zinc present in surface soils at the former MBR site does not pose an unacceptable risk to human health.***

Table 7-1: Maximum Metal and Explosive Compounds Concentrations Detected in Soil

Analyte	Tier 1 EAL[1] (mg/kg)	Maximum Concentration at Site (mg/kg)	95% UCL of DU with Maximum Concentration	Increment Sample Yielding the Highest Concentration
Metals/Inorganics (SW-846 6010B/6020) (mg/kg)				
Lead (Pb)	200	110	126	MBR-09
Copper (Cu)	626	63	66	MBR-09
Antimony (Sb)	2.4	2.1	2.61	MBR-08
Zinc (Zn)	1,000	140	147	MBR-09
Explosives (SW-846 8330B) (mg/kg)				
2-Amino-4,6-dinitrotoluene	0.70	U (< 0.05)	0.13	MBR-07
4-Amino-2,6-dinitrotoluene	0.70	U (< 0.05)	0.13	MBR-07
3,5-Dinitroaniline	NS	U (< 0.05)	0.13	MBR-07
1,3-Dinitrobenzene	1.2	U (< 0.05)	0.13	MBR-07
2,4-Dinitrotoluene	1.6	U (< 0.05)	0.13	MBR-07
2,6-Dinitrotoluene	4.3	U (< 0.05)	0.13	MBR-07
HMX	29.1	U (< 0.05)	0.13	MBR-07
Nitrobenzene	2.3	U (< 0.05)	0.13	MBR-07
Nitroglycerin	1.2	U (< 0.25)	0.25	MBR-07
4-Nitrotoluene	30.3	U (< 0.05)	0.13	MBR-07
2-Nitrotoluene	1.9	U (< 0.05)	0.13	MBR-07
3-Nitrotoluene	22.7	U (< 0.05)	0.13	MBR-07
(pentaerythrite tetranitrate) PETN	24.4	U (< 0.25)	0.25	MBR-07
(cyclotrimethylene trinitramine) RDX	2.8	U (< 0.05)	0.13	MBR-07
Tetryl	48.9	U (< 0.05)	0.13	MBR-07
1,3,5-Trinitrobenzene	8.4	U (< 0.05)	0.13	MBR-07
2,4,6-Trinitrotoluene	7.2	U (< 0.05)	0.13	MBR-07

[1]*Tier 1 EAL = Unrestricted land use at sites where surface water is located within 150 meters of the release site and where the site is underlain by a non-drinking water resource (Table B-2, HDOH 2012).*
U = Undetected at the Limit of Detection (Value in Parenthesis).

7.6 MC ECOLOGICAL SCREENING LEVEL RISK ASSESSMENT

On-site Natural Resource Support (NRS) was provided from February 25, 2013 to April 4, 2013 during the entire transect survey, vegetation clearing and MC sampling work (Appendix H). No naturally occurring Threatened or Endangered Species (TES), including animals, birds, or invertebrates, were observed within the former MBR during the field investigation (Garcia and Associates, 2013). There was, however, one experimental out-planting population of federally listed threatened *Tetramolopium rockii* planted by NPS personnel located on a MEC transect. It was flagged and avoided during the course of fieldwork. The NRS biologists noted that the

portion of the former MBR that contained the highest MEC density was dominated by non-native vegetation.

The HDOH guidance for Evaluation of Environmental Hazards at Sites with Contaminated Soil and Groundwater (HDOH, 2011b) states that a site-specific, ecological risk assessment is only required if sensitive, terrestrial or aquatic habitats are present within or near areas of contaminated soil. No energetic compounds were detected in the thin soils present at the former MBR site and the maximum levels of metals detected at the site were below HDOH Tier 1 EALs and not significantly elevated above background levels. In addition, the area where UXO and MD were discovered during the current investigation is dominated by non-native vegetation and does not provide habitat for any TES. ***It is concluded that there is no evidence explosive compounds are present in the soil; and exposure to MC metals antimony, copper, lead and zinc present in surface soils at the former MBR site does not pose an unacceptable risk to ecological health.***

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CHAPTER 8. SUMMARY AND CONCLUSIONS

The objective of this project was to characterize the nature and extent of MEC and MD. RI field activities were conducted at MBR from February 25 to April 17, 2013. All activities during the phases of fieldwork were conducted in full compliance with USACE, HDOH, and local requirements regarding personnel, equipment, and procedures. Standard Operating Procedures (SOPs) for the project's Definable Features of Work (DFWs) were used as described in the RI Work Plan. The provisions of the OSHA Standard 29 CFR 1910.120 and 29 CFR 1926.65 were applied to all MEC/MD-related actions taken at this site. Field activities included vegetation removal, 100% transect anomaly clearance (surface and subsurface) and MC sampling.

The MBR consists of 713.25 acres; 552.95land and 160.30 water as calculated in GIS (937 acres; 832 land and the remaining 105 tidal water reported as currently reported in FUDSMIS). The goal of the RI was to characterize the nature and extent of the MEC and MC for the land portion of the site. For MEC, 100% anomaly investigation of transects with 100% coverage of the land portion of site was conducted. The water portion of the site was not investigated due to the dangerous sea conditions caused by a rocky shoreline, constant high waves and strong currents. The transect spacing was such that there is:

- A 95% confidence level that target areas have been detected.
- A 95% confidence that area of non-MEC contamination have < 0.5 UXO per acre , and
- A 95% confidence level that MEC-contaminated areas have been to an accuracy of ± half the transect spacing, maximum 250 ft.

The following subsections summarize the field activities conducted and their results.

8.1 SUMMARY OF TRANSECT INVESTIGATION

The MBR transect miles completed were 17.14 miles, equaling 8.31 total acres. All transects were 100% investigated on surface and in subsurface. Quality Control of transects equaled 100 percent of the completed transects. MAJV investigated 100 percent of the anomalies identified within transects.

Transects were relegated to a 4-ft width and depth of anomaly. The handheld analog metal detector (Minelab Explorer II) was the instrument used for the transect investigation.

Vegetation and terrain conditions through the majority of the work were extreme. Vegetation Removal and Transect Anomaly Investigation daily production rates were less than anticipated.

The investigation of the anomalies within transects resulted in the discovery of 99 MPPEH items and 1,024 lbs of MD.

The data collected match prior investigations reports with respect to both munitions type and location, no unexpected munitions were encountered.

Table 8-1 presents a summary of Transect Investigation UXO and MD findings by type, number of each type, depth ranges, and pounds of MD observed during the RI fieldwork.

8.2 SUMMARY OF MC SAMPLING

For evaluation of the presence of MC, IS soil sampling was conducted in five (5) Decision Units (DUs); three (3) within the high UXO/MD density area and two (2) within the areas where no UXO or MD were found (for MC metals background comparison values). Groundwater beneath the site is not potable. No surface water other than the Pacific Ocean is present onsite.

MC metals (lead, copper, antimony, and copper) and explosive compounds were analyzed. No explosives were detected. Lead, copper, antimony, and zinc were detected in samples collected within the target area, but did not exceed HDOH Tier 1 EALs.

It is concluded that there is no evidence explosive compounds are present in the soil; and exposure to MC metals (antimony, copper, lead and zinc) present in surface soils at the former MBR site does not pose an unacceptable risk to human or ecological health.

Table 8-1: Summary of Transect Investigation

UXO			MD		
Item	**#**	**Depth Range (in.)**	**Items**	**Wt. (lb)**	**Depth Range (in.)**
3 lb Practice Bomb, AN-Mk 5	25	0-18	3 lb Practice Bomb, AN-Mk 5 (28 intact +frag)	1,024	0-24
3 lb Practice Bomb, AN-Mk 23	51	0-18	3 lb Practice Bomb, AN-Mk 23 (57 intact + frag, tail fin)		
4.5 lb Practice Bomb, AN-Mk 43	5	1-2	4.5 lb Practice Bomb, AN-Mk 43 (2 intact + frag)		
13 lb Practice Bomb, AN-Mk 19	18	0-12	13 lb Practice Bomb, AN-Mk 19 (2 intact + frag)		
			Unidentifiable Frag		
			Expended Small Arms Ammunition		
			Two Bomb Ejector Racks		
Total Amount	**99**			**1,024**	

No MEC types other than UXO, no target remnants, or materials other than the identified UXO/MD were observed in the Range Complex No. 1 MRS during the RI conducted in February and April 2013.

The amount and quality of data collected is considered sufficient to characterize the site.

8.3 MRSPP SCORING SUMMARY

Draft Munitions Response Site Prioritization Protocol (MRSPP) scoring tables were completed for both the target area and the area where no UXO/MD were found in the Remaining Lands of Range Complex No. 1 MRS. MRSPP Scoring Tables can be found in Appendix G. Table 8-2 summarizes the MRSPP scoring.

Table 8-2: MRSPP Summary

MRS	Acreage	EHE Module Rating	CHE Module Rating	HHE Module Rating	MRS Priority Rating
Range Complex No. 1 - Target Area	232.84[(1)] (land)	5	No Known or Suspected CHE Hazard	No Known or Suspected MC Hazard	5
Range Complex No. 1- Remaining Lands	483.17 (322.87 land, 160.30 tidal water)	No Known or Suspected Explosive Hazard	No Known or Suspected CWM Hazard	No Known or Suspected MC Hazard	No Known or Suspected Hazard

(1) The delineated target area recommended for FS includes the heiau and 2.76 acres outside the FUDS property boundary recommended for future inclusion.

8.4 MUNITIONS AND EXPLOSIVES OF CONCERN HAZARD ASSESSMENT (MEC HA) SCORING

Potential explosive hazards from UXO at the site were evaluated using the United States EPA's MEC HA methodology (EPA 2008). The results of the MEC HA analysis for the target area of Range Complex No. 1 MRS are summarized in Table 8-3. An explosive hazard is not present in the Remaining Lands and a MEC HA was not performed for that area.

The Range Complex No. 1 – Target Area is evaluated as Hazard Level 2. Sites with this hazard level maintain a high potential explosive hazard with possible imminent threat to human health from an interaction with MEC.

Table 8-3: Baseline Munitions and Explosives of Concern Hazard Assessment (MEC HA)

MRS	Acreage	Status	Hazard Level Category	Score	Remarks
Range Complex No. 1 - **Target Area**	232.84 [(1)] (land)	Baseline	2	795	UXO/MD present As a result of UXO and MD findings, the interaction between park personnel/ recreational users and UXO was demonstrated.

(1) The delineated target area recommended for FS includes the heiau and 2.76 acres outside the FUDS property boundary recommended for future inclusion.

8.5 RECOMMENDATIONS

The Range Complex No. 1 MRS is recommended to be re-delineated into two areas as summarized in Table 8-4 and shown on Figure 8-1. The new boundaries are recommended based on level of explosive hazard present in each area determined by UXO/MD findings encountered during historical site visits and the 2013 RI. Separating the MRS area into two areas allows each area to be addressed in a cost-efficient and sensible manner appropriate to the explosive hazard present within each area.

8.5.1 Range Complex No. 1 – Target Area

The Target Area (230.08 acres land within the FUDS property boundary, including the 2.22 acre Heiau) is recommended to proceed to the next step in the CERCLA process, evaluation of remedial alternatives through a FS for a remediation action of MEC (explosive hazard from UXO present onsite).

The re-delineation of the Target Area extends 2.76 acres outside the FUDS boundary. The extension outside the FUDS boundary is recommended due to the close proximity of MD to the site boundary. It is recommended the newly included acreage be processed for inclusion in the FUDS boundary. The inclusion of this area would bring the total Target Area acreage to 232.84 acres, and the total MBR FUDS acreage to 716.01 acres.

A classification of NDAI is recommended for MC in Range Complex No. 1-Target Area. No suspected unacceptable risk to human or ecological receptors from MC is present related to DoD activity.

8.5.2 Range Complex No. 1 – Remaining Lands

The Remaining Lands (483.17 acres: 322.87 land and 160.30 tidal water) is recommended to proceed to a NDAI determination for both MEC and MC based on finding no evidence of suspected unacceptable hazards from MEC or risks from MC related to DoD activity.

The entire tidal water portion of the site is included in the Remaining Lands. Based on the MEC investigation of the land and the location of the target area, and the fact the dangerous sea conditions would not attract recreational boaters or divers, no further investigation of the tidal water areas is recommended.

Table 8-4 summarizes the Recommendations for each MRS.

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Table 8-4: Recommendation Summary

MRS	Acreage	Recommendation	Basis for Recommendation MEC/MD/MC	MRSPP Priority
Range Complex No. 1 -**Target Area**	232.84 (1) (land)	MEC – FS	**MEC:** 99 UXO items in the form of practice bombs with signals found during the 2013 RI. **MD:** 1,024 lbs removed.	5
		MC – NDAI	**MC:** Concentrations of MC metals (antimony, copper, lead and zinc) below HDOH EALs. No detection of explosives. No surface water other than ocean located on site, Groundwater is not potable within the MRS. No unacceptable risk to human or ecological receptors is present from exposure to surface soils in this area.	No known or suspected hazards
Range Complex No. 1 -**Remaining Lands**	483.17 (322.87 land; 160.30 tidal water)	MEC – NDAI	**MEC:** No evidence of UXO, DMM, or explosive soils. **MD:** Only very low densities of expended small arms ammunition were observed.	No known or suspected hazards
		MC – NDAI	**MC:** Concentrations of MC metals (antimony, copper, lead and zinc) below HDOH EALs. No detection of explosives. No surface water other than ocean located on site, Groundwater is not potable within the MRS. No unacceptable risk to human or ecological receptors is present from exposure to surface soils in this area.	No known or suspected hazards

(1) The target area recommended for FS includes the heiau and 2.76 acres outside the FUDS property boundary recommended for future inclusion.

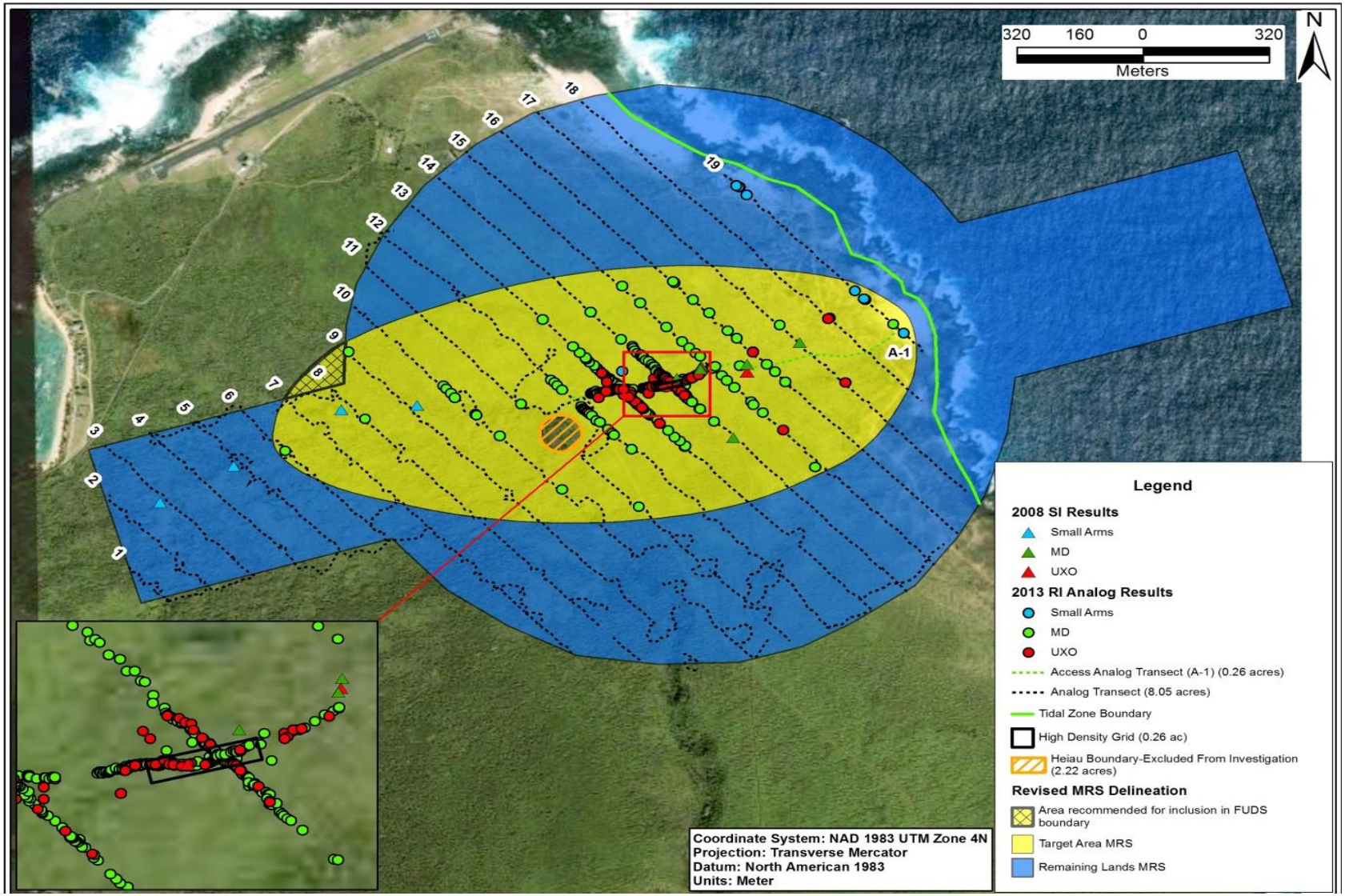

Figure 8-1: Proposed MRS Boundaries

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