# FEASIBILITY STUDY REPORT

**For:**

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

**ISLAND OF MOLOKAI, HAWAII**

**Prepared for**

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

Prepared by

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**FINAL**
April 2014

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# EXECUTIVE SUMMARY

## ES.1 INTRODUCTION

This Feasibility Study (FS) Report documents the development and evaluation of remedial alternatives for the former Makanalua Bombing Range (MBR), Formerly Used Defense Sites (FUDS) Project No. H09HI020301 Range Complex No. 1 – Target Area Munitions Response Site (MRS) located on the Island of Molokai, Hawaii. The target area of this MRS as defined in the 2013 Remedial Investigation (RI) is undergoing an FS to evaluate remedial alternatives for Munitions and Explosives of Concern (MEC) remaining onsite from historical military activities. This FS also addresses the State of Hawaii Department of Health (HDOH) Office of Hazard Evaluation and Emergency Response (HEER) requirements for a Remedial Alternatives Action (RAA) Report. The FS is prepared as a separate document from the RI Report.

An RI was conducted in 2013 by Malama Aina Joint Venture (MAJV) (MAJV, 2013) to characterize the nature and extent of MEC and Munitions Constituents (MC) at the MRS. Based on the results of the RI, the site was delineated into two areas. The area where no evidence of MEC was found was recommended to proceed to No Department of Defense Action Indicated (NDAI). The center of the MRS, where MEC and Munitions Debris (MD) from potential MEC was found, was delineated as the Target Area and recommended for FS. Both areas are shown on Figure ES-1. Sampling and risk assessment indicated no unacceptable risk was present for MC; therefore, this FS only addresses MEC.

The FS work is being performed under The U.S. Army Corps of Engineers (USACE) Contract W912PP-11-C-0035. The contract is administered jointly by the USACE Honolulu District (CEPOH) and Sacramento District (CESPK).

The site is located within the Kalaupapa National Historic Park, owned by the State of Hawaii and managed by the HDOH, the National Park Service (NPS), and the State of Hawaii Department of Land and Natural Resources (DLNR). The MRS is managed under the Military Munitions Response Program (MMRP), administered under the Defense Environmental Restoration Program (DERP) by CEPOH. The MRS is being investigated under the guidance provided by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the USACE is the lead agency responsible for the remedial effort. The HDOH currently provides park management and regulatory oversight. However, when patient care is no longer needed, HDOH will continue involvement in regulatory oversight, and likely withdraw involvement in park management.

The main objectives of this FS are to evaluate potential remedial alternatives and to provide decision makers with enough information to choose an appropriate remedial response to address risks posed to human health by MEC at the MRS.

In consultation with the HDOH, NPS and with input from the public, USACE will use these objectives to select an appropriate remedial alternative for the MRS.

To meet the objectives, the scope of this FS includes the following:

- Summarizes site characteristics and describing the Conceptual Site Model (CSM).
- Develops the Remedial Action Objectives (RAOs).
- Identifies General Response Actions (GRAs) and remedial alternatives that address the RAOs.
- Conducts a detailed analysis of the identified remedial alternatives according to the standard CERCLA evaluation criteria; and
- Provides information for decision makers to select an alternative.

In accordance with the Remedial Investigation/Feasibility Study (RI/FS) guidance document (USEPA, 1988) and information required by the National Contingency Plan (NCP) (40 Code of Federal Regulations [CFR] 300.430[e]), the FS for the Range Complex No. 1 – Target Area MRS consists of the following three main phases:

- Developing remedial alternatives
- Screening the alternatives; and
- Conducting a detailed analysis of the alternatives.

## ES.2 SITE BACKGROUND AND SUMMARY OF PRIOR INVESTIGATIONS

Based on documentation, research, the 2008 Site Inspection (SI), and the 2013 RI, 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 Unexploded Ordnance (UXO), AN-Mk5 and AN-Mk19, practice bombs, and numerous expended practice bombs.

The former MBR site is located within the Kalaupapa National Historic Park, owned by the State of Hawaii and managed by the NPS, State of Hawaii DLNR, and HDOH. It is a significant historical and archaeological place and no future development of the site is planned. 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 the portion of the Kalaupapa Peninsula that is typically visited by visitors to the National Park.

Current 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.

An RI was conducted from February 2013 to April 2013, to further investigate the site for the presence of MEC and MC.

The MBR RI transect miles completed were 17.14 miles, equaling 8.31 total acres. Transect spacing and locations, established in Visual Sampling Planning (VSP) 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.

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. UXO and MD were removed from the surface and to a depth of 24 inches. The data collected correlated with prior investigations findings and no unexpected munitions were encountered.

For evaluation of the presence of MC, Incremental Sampling (IS) of surface soil (0 to 3 in. bgs) was conducted in five Decision Units (DUs); three within the higher UXO/MD density areas and two from areas of the site where no UXO or MD were 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 perennial 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.3 RI RECOMMENDATIONS

Range Complex No. 1 MRS was recommended in the RI to be re-delineated into two areas as described below and shown in Figure ES-1. The new boundaries were recommended based on the 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.

### Range Complex No. 1 – Target Area

The Target Area (230.08 acres, land within the current FUDS Property boundary, including the 2.22-acre *heiau*, was 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 on site).

This realignment 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 937 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.

### Range Complex No. 1 – Remaining Lands

The Remaining Lands (704.16 acres: 599.16 land and 105 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 Department of Defense (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.

## ES.4 FS RESULTS AND RECOMMENDATIONS

### Contaminants of Concern

For consideration in the FS, the contaminants of concern and the source of the hazard present on site are MEC in the form of UXO remaining from past DoD training operations. The types of UXO anticipated include practice bombs with low explosive fragmenting fillers. No High Explosive (HE) munitions were found. An explosive hazard is present for park employees and site visitors who venture into the area and may potentially interact with the UXO items.

### Exposure Areas

The alternatives presented in the National Park Service (NPS) General Management Plan (GMP) under development include varying levels of visitor controls; all are highly restrictive. The least restrictive of the options could involve camping limited to restricted areas and unescorted visitor access on selected trails. This FS will conservatively consider aspects of the least restrictive alternative as a guide to the future uses of the site. This alternative allows visitors access to a trail that follows the coastline and enters into the northeast area of the Range complex No. 1 Target Area MRS. A dirt road runs through the center of the MRS from the lighthouse to the Kahauko volcano. Current GMP alternatives under consideration do not allow visitor access to this trail, but it is assumed park personnel and potential visitors use it and disoriented visitors could gain access to it.

**Remedial Action Objectives (RAOs)**

The RAOs for remedial actions at the Range Complex No. 1 – Target Area MRS are established on the explosive hazard present based on the 2013 RI findings and the following site-specific information.

- The contaminant of interest at the MRS is MEC, in the form of UXO from practice bombs with low explosive fragmenting fillers. Based on findings from the 2013 RI, UXO is present on the surface and to a depth of 18 inches.
- The media requiring consideration of potential response action is the surface and subsurface soil of the site.
- The pathways for exposure to UXO are surface activities from visitors and park personnel at the Kalaupapa National Historic Park who venture out of the settlement. Visitors are currently required to have an escort to leave the Settlement.

The Kalaupapa National Historic Park is a significant cultural place due to the Kalaupapa Settlement and numerous archaeological sites remaining from the native Hawaiians who inhabited the land before relocation at the time the Settlement was established. The area has many locations considered sacred that create a special spirit and character to the land. The site is also a significant ecological place due to the presence of threatened and endangered species and sensitive habitats.

The only intrusive activity anticipated is installation of signage.

Based on these considerations, the following RAOs have been developed for the MRS:

- Reduce potential explosive safety hazards by preventing interaction between receptors (site visitors and park personnel) and intact MEC on the surface.
- Ensure current and future land use is compatible with the option chosen.
- Preserve the historical and spiritual character of the park setting to the maximum extent practicable.
- Protect sensitive biological and archaeological resources to the maximum extent practicable.

**Preliminary Remediation Goals**

The preliminary remediation goal for MEC is to limit interaction between MEC and receptors accessing the MRS.

The Land Use assumed for the FS is surface use only: No intrusive activity is permitted beyond installation of signage with UXO avoidance support present, Site Visitor access is limited to the trail along the shore line, and park personnel access the road leading through the center of the site.

Remedial Technology and Alternative Evaluation

The viable remedial technologies for further response action were identified through review and assembly of General Response Actions (GRAs) which could potentially meet RAOs. Several remediation technologies were identified and subsequently screened for effectiveness, implementability, and cost. The remedial technologies retained from the initial screening step were then combined into an array of remedial alternatives, and the alternatives screened again based on relative effectiveness, implementability, and cost. All remedial alternatives considered for the MRS are summarized in Table ES-1.

Alternative 7 was eliminated from the full evaluation due to the high destruction of the environment.

A detailed analysis of the remedial alternatives was completed using the following criteria specified in the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, 1988): overall protection of human health and the environment; compliance with Applicable or Relevant and

Appropriate Requirements (ARARs); long-term effectiveness and permanence; short-term effectiveness; reduction of mobility, toxicity, or volume through treatment; implementability; and cost.

Based on evaluation against the above criteria, Alternative-4 Surface MEC Removal of the trail near the shoreline, the road at site center, and the high MEC density area was determined to be most favorable and best satisfy the RAOs for the site, because it does the following:

- Provides overall protection to human health and only a moderate destruction of the environment. Sensitive species and their habitats are protected.
- Removes UXO in areas most likely to be encountered by site visitors, and in the area where they are most concentrated.
- Provides a mechanism for re-evaluation of remedy as site access conditions change.
- Provides Site visitors an awareness of the potential hazard present, and information on what to do if UXO is encountered on site.

Following stakeholder acceptance, a Proposed Plan (PP) will be developed and presented.

**Table ES-1: Summary of Remedial Alternatives and Preferred Alternative**

| Alternative | Description of MEC Removal Alternative | Ranking [(1)] |
|---|---|---|
| **Range Complex No. 1 MRS – Target Area** | | |
| Alternative - 1<br>No Action | No action taken. | 22 |
| Alternative - 2<br>LUCs | Signage, Access restrictions, Land Use limited to non-intrusive activities, Public Education, 5-year reviews. | 23 |
| Alternative - 3<br>Full Surface MEC Removal of Target Area MRS, LUCs | Surface MEC Removal within entire Target Area MRS (233 acres), LUCs, and 5-year reviews. | 32 |
| Alternative - 4<br>Surface MEC Removal<br>(trail, dirt road, and high MEC density area), LUCs | Surface MEC Removal along and 25 ft either side of trail and dirt road within Target Area, and in high MEC density area (37.74 Total acres), LUCs, and 5-year reviews | 19 |
| Alternative - 5<br>Surface MEC Removal<br>(trail and dirt road) and<br>Surface/Subsurface Removal<br>(high MEC density area), LUCs | Surface MEC Removal along and 25 ft either side of trail and dirt road (4.59 acres) within Target Area and Surface / Subsurface MEC Removal of high MEC density area (33.15 acres), LUCs, and 5-year reviews | 20 |
| Alternative - 6<br>Surface/Subsurface MEC Removal<br>(trail, dirt road, and high MEC density area), LUCs | Surface / Subsurface MEC Removal along and 25 ft either side of trail and dirt road within Target Area and in high MEC density area (37.74 acres), LUCs, and 5-year reviews. | 21 |
| Alternative - 7<br>Surface/Subsurface MEC Removal to support Unlimited Use/ Unrestricted Exposure | Full Surface / Subsurface MEC Removal within the Target Area MRS (233 acres) to 10 ft or bedrock, whichever is encountered first. | Eliminated due to high environmental destruction |

Note 1: Lower score preferred.

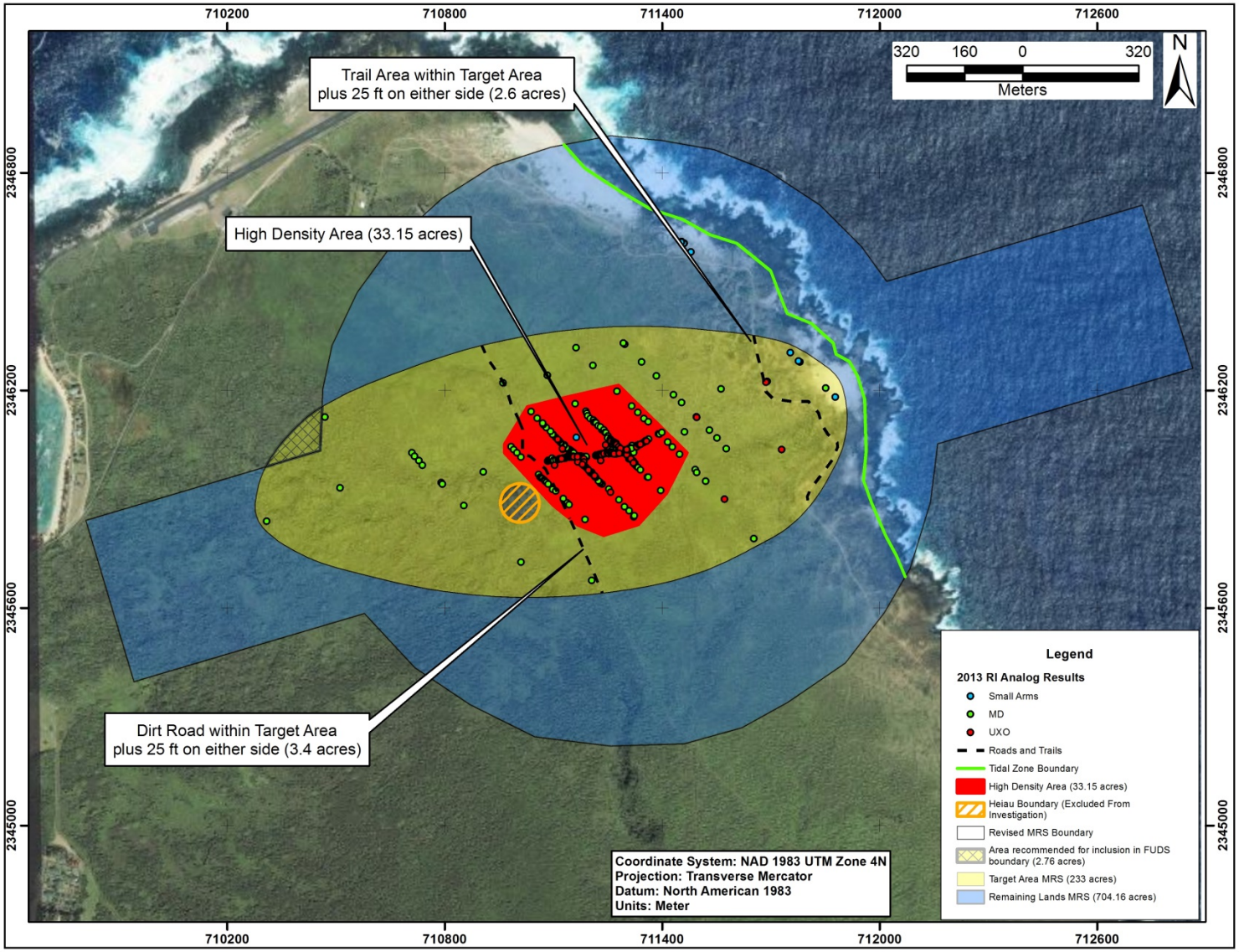


**Figure ES-1: Former MBR Re-alignment and Potential MEC Removal Areas**

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| | |
|---|---|
| BIP | Blow in Place |
| bgs | below ground surface |
| BUD | Berkley UXO Detector |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| CEMVR | United States Army Corps of Engineers, Rock Island District |
| 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 |
| CSM | Conceptual Site Model |
| CWM | Chemical Warfare Materiel |
| DD | Decision Document |
| DERP | Defense Environmental Restoration Program |
| DGM | Digital Geophysical Mapping |
| DLNR | Department of Land and Natural Resources |
| DMM | Discarded Military Munitions |
| DoD | Department of Defense |
| DU | Decision Unit |
| EAL | Environmental Action Level |
| EHE | Explosive Hazard Evaluation |
| EP | Engineer Pamphlet |
| ER | Engineer Regulation |
| EPA | U.S. Environmental Protection Agency |
| FDE | Findings and Determination of Eligibility |
| FS | Feasibility Study |
| FUDS | Formerly Used Defense Sites |
| FUDSMIS | Formerly Used Defense Sites Management Information System |
| GIS | Geographical Information System |
| GMP | General Management Plan |
| GRA | General Response Action |
| HDOH | Hawaii Department of Health |
| HE | High Explosive |
| HEER | Hazard Evaluation and Emergency Response |
| HHE | Health Hazard Evaluation |
| INPR | Inventory Project Report |
| IS | Incremental Sampling |
| LUC | Land Use Control |

| | |
|---|---|
| LUCIP | Land Use Control Implementation Plan |
| MAJV | Malama Aina Joint Venture LLC |
| MBR | Makanalua Bombing Range |
| MC | Munitions Constituents |
| MD | Munitions Debris |
| MDAS | Material Documented as Safe |
| MEC | Munitions and Explosives of Concern |
| MEC HA | Munitions and Explosives of Concern Hazard Assessment |
| MMRP | Military Munitions Response Program |
| MRS | Munitions Response Site |
| MRSPP | Munitions Response Site Prioritization Protocol |
| msl | mean sea level |
| NCP | National Contingency Plan |
| NDAI | No Department of Defense Action Indicated |
| NHL | National Historic Landmark |
| NPS | National Park Service |
| NRCS | National Resources Conservation Service |
| NRHD | National Register of Historic Districts |
| NRHP | National Register of Historic Places |
| NRIS | National Register Information System |
| NRS | Natural Resource Support |
| O&M | Operations & Maintenance |
| PDT | Project Delivery Team |
| PP | Proposed Plan |
| PRG | Preliminary Remediation Goal |
| QC | Quality Control |
| RAA | Remedial Alternatives Action |
| RAO | Remedial Action Objective |
| RI | Remedial Investigation |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record of Decision |
| ROD/DD | Record of Decision/Decision Document |
| ROE | Right of Entry |
| SARA | Superfund Amendments and Reauthorization Act |
| SHPD | State Historic Preservation District |
| SI | Site Inspection |
| TBC | To Be Considered |
| T&E | Threatened and Endangered |
| TPP | Technical Project Planning |
| TTU | Thermal Treatment Unit |

| | |
|---|---|
| UU/UE | Unlimited Use/Unrestricted Exposure |
| USACE | United States Army Corps of Engineers |
| USAE | USA Environmental |
| USEPA | United States Environmental Protection Agency |
| USC | United States Code |
| UXO | Unexploded Ordnance |
| VSP | Visual Sampling Planning |

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# Chapter 1. INTRODUCTION

## 1.0 INTRODUCTION

This FS Report documents the development and evaluation of remedial alternatives for the MBR, FUDS Project No. H09HI020301, Range Complex No. 1 - Target Area MRS located on the Island of Molokai, Hawaii (Figure 1-1). The target area of this MRS, as defined in the 2013 RI, is undergoing an FS to evaluate remedial alternatives for MEC remaining onsite from historical military activities. This FS also addresses the HDOH Office of HEER requirements for a RAA Report.

A RI was conducted in 2013 by MAJV (MAJV, 2013) to characterize the nature and extent of MEC and MC at the MRS. The RI recommended the site be delineated into two areas. The area where no evidence of MEC was found was recommended to proceed to NDAI. The center of the MRS where MEC and MD from potential MEC found was delineated as the Target Area and recommended for FS, the next step in the CERCLA process. Both areas are shown on Figure 1-2. Sampling and risk assessment indicated no unacceptable risk was present for MC; therefore, this FS only addresses MEC and not MC.

The FS work is being performed under USACE Contract W912PP-11-C-0035. The contract is administered jointly by the USACE CEPOH, and the USACE CESPK.

The site is located within the Kalaupapa National Historic Park, owned by the State of Hawaii and managed by the HDOH, the NPS, and the DLNR. The MRS is managed under the MMRP, administered under the DERP by CEPOH. The MRS is being investigated under the guidance provided by the CERCLA, and the Army Corps of Engineers is the lead agency responsible for the remedial effort. The HDOH currently provides park management and regulatory oversight. However, when patient care is no longer needed, HDOH will continue involvement in regulatory oversight, and likely withdraw involvement in park management.

## 1.1 PROJECT BACKGROUND

The former MBR as currently reported in the Formerly Used Defense Sites Management Information System (FUDSMIS) consists of one MRS totaling 937 acres (832 land acres and 105 tidal water acres). *Note: Site acreage calculated with Geographical Information System (GIS) is 713.27 acres: 582.22 land acres and 131.02 water acres.* The acreages reported in the document, and on maps, use the FUDSMIS 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 of 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.

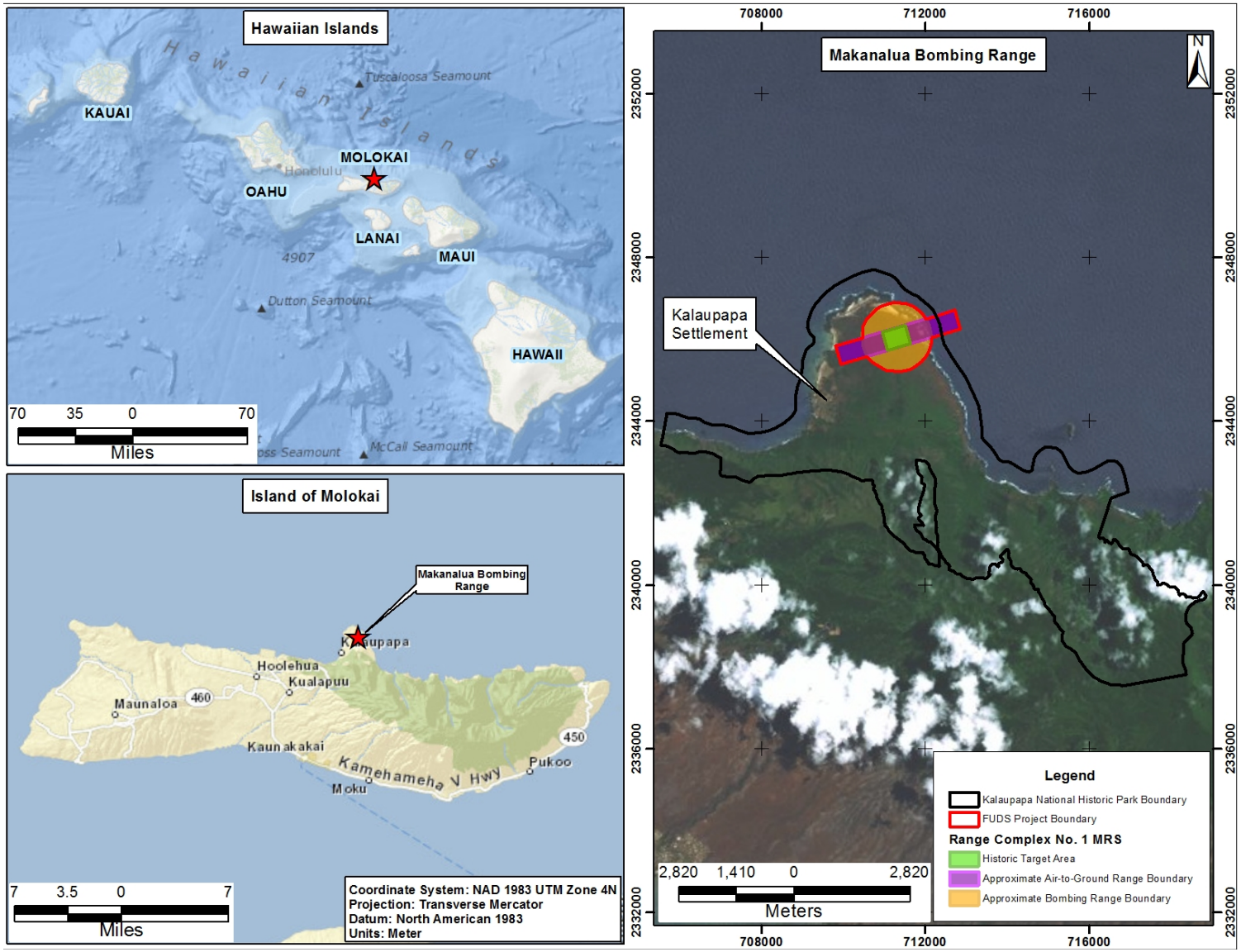


**Figure 1-1: Site Location**

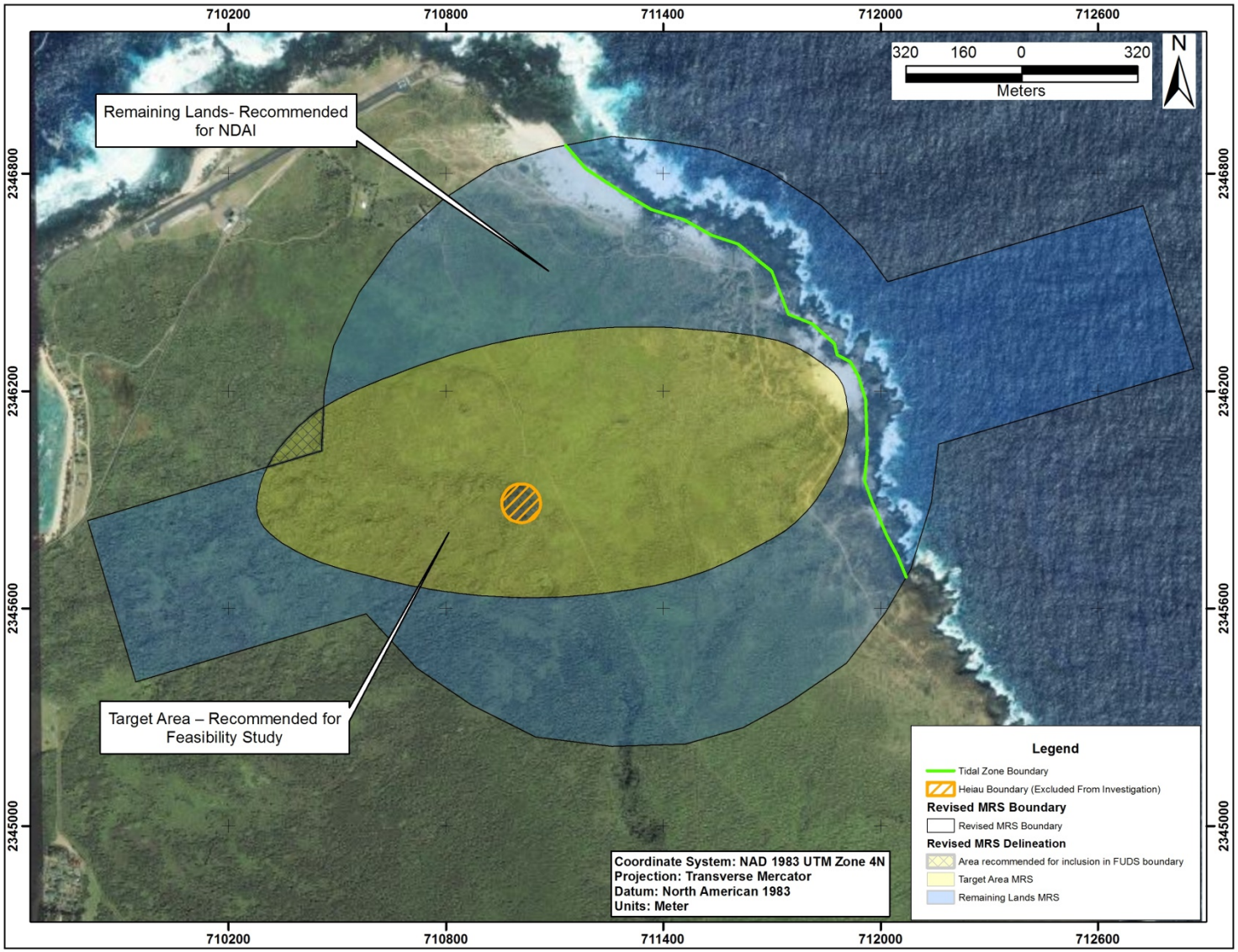


**Figure 1-2: Realignment of Range Complex No. 1 MRS.**

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 Inventory Project Report (INPR) consisted of approximately 160 acres. The 2004 INPR Supplement increased the acreage to 937 acres to include the bombing range and rocket range buffer areas. There is no historical evidence that Chemical Warfare Materiel (CWM) is present on the MRS.

### 1.1.1 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.

### 1.1.2 2004 INPR Supplement

The 2004 INPR Supplement summarizes the information from the 1991 INPR and other associated investigations. The INPR Supplement provided a summary of the MRS It 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 to 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).

### 1.1.3 2008 Site Inspection Summary

The 2008 SI 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 SI 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 surface soil sample collected from a 160-acre (DU, comprised of 100 soil increments. The sample was collected in triplicate from a depth range of 0 to 2 in. below ground surface (bgs) for analysis of potential MC (explosives, antimony, copper, lead, mercury, and zinc). An ambient surface soil sample [30- x 30-ft Decision Unit (DU), 30 increments] was collected within the MRS in triplicate using the 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).

### 1.1.4 2013 Remedial Investigation Summary

An RI was conducted from February 2013 to April 2013, to further investigate the site for presence of MEC and MC.

The MBR transect miles completed were 17.14 miles, equaling 8.31 total acres. Transect spacing and locations, established in VSP 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 the 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 lb 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. UXO and MD were removed from the surface and to a depth of 24 inches. The data collected correlated with prior investigations findings and no unexpected munitions were encountered. No Discarded Military Munitions (DMM) were found.

For evaluation of the presence of MC, IS sampling of surface soil (0 to 3 in. bgs) was conducted in five DUs, three within the high UXO/MD density area and two from areas of the site where no UXO or MD were 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 on site. 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 EALs. ***There is no evidence that 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.***

Based on the results of the 2013 RI, the Range Complex No. 1 MRS was recommended to be re-delineated into two areas as described below, summarized in Table 1-1 and shown in Figure 1-2. The new boundaries were 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.

#### 1.1.4.1 Range Complex No. 1 – Target Area

The Target Area (230.08 acres, land within the current 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 on site).

This realignment 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 937 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.

#### 1.1.4.2 Range Complex No. 1 - Remaining Lands

The Remaining Lands (704.16 acres: 599.16 land and 105 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 1-1: 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** | 704.16 (599.16 land; 105 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.

## 1.2 PURPOSE AND ORGANIZATION OF THE REPORT

The NCP, 40 CFR, Part 300.430, subpart (e) states that "The primary objective of the FS is to ensure that appropriate remedial alternatives are developed and evaluated and an appropriate remedy selected." The main objectives of this FS are therefore to evaluate potential remedial alternatives and to recommend the most appropriate remedial approach to address risks posed to human health by MEC at the MRS. To satisfy the U.S. Environmental Protection Agency (EPA) criteria, the selected remedial alternative must do the following:

- Protect human health and the environment.
- Comply with ARARs of federal and state environmental laws.
- Use permanent solutions and innovative treatment technologies to the extent practicable.
- Satisfy the regulatory preference for treatment that reduces contaminant toxicity, mobility, or volume.
- Address the short-term effectiveness of the solution during the period of time needed to implement the remedy and any adverse impacts that may affect workers, the community, and the environment during implementation. (MEC removal risks must be considered and controlled).
- Be cost-effective and implementable.
- Be acceptable to state regulatory agencies and the public.

In consultation with the HDOH, NPS, and with input from the public, USACE will use these objectives to select an appropriate remedial alternative for the MRS.

To meet the objectives, the scope of this FS includes the following:

- Summarizes site characteristics and describing the (CSM.
- Develops the RAOs.
- Identifies GRAs and remedial alternatives that address the RAOs.
- Conducts a detailed analysis of the identified remedial alternatives according to the standard CERCLA evaluation criteria.
- Provides information for decision makers to select an alternative.

Following completion of the FS, the chosen preferred remedial action will be detailed in a Proposed Plan (PP) for the site. After responding to any public comments on the PP, the identified remedy will be formally selected and documented in a Decision Document (DD), according to the NCP.

## 1.3 MUNITIONS RESPONSE SITE

This FS addresses the 232.84 acre target area of Range Complex No. 1 delineated in the 2013 RI. No tidal water is included in this area. The FS will address MEC hazards present. The delineated target area recommended for FS includes the *heiau* and 2.76 acres outside the FUDS property boundary.

No hazard from MC was identified to human or ecological receptors in the 2013 RI; MC will not be addressed in the FS.

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# Chapter 2. SITE BACKGROUND INFORMATION

## 2.0 SITE DESCRIPTION

### Location and Topography

The former MBR is located on Kalaupapa Peninsula, Molokai, Hawaii (Figure 1-1), which has an elevation that varies from approximately 0 to 25 ft mean sea level (msl). The terrain varies from generally flat or gently sloping to short, steep gullies and rock formations.

### 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 are 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 ‘a‘ā 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).

In most areas, 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. However, in depositional areas, items in the RI were recovered to 18 inches in depth.

### 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 MRS. No perennial surface water or sediment is present on site.

### 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 (NHL). According to the National Register Information System

(NRIS), National Register of Historic Places (NRHP), National Register of Historic Districts (NRHD), and 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 NPS. According to the State Historic Preservation Division (SHPD) website databases, archaeological/cultural resources are 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).

**Biological Resources**

According to the U.S. Fisheries and Wildlife Service, 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 federally listed animal species with habitats present on the Island of Molokai include: the Hawaiian hoary bat (*Lasiurus cinereus semotus*), Hawaiian monk seal (*Monachus schauinslandi*), Molokai thrush (*Myadestes lanaiensis*), 'o'u (*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).Although no federally listed threatened or endangered wildlife species were encountered by the field teams, habitats for the listed species, such as, Hawaiian hoary bat and Hawaiian monk seal, are present within MBR and it is possible they are present.

Two federally listed endangered plants, lava slope centaury (*Centaurium sebaeoides*) and dune tetramolopium (*Tetramolopium rockii*), are known to inhabit the eastern coastline of the peninsula. The coastal area of the MBR project boundary contains critical habitat for these two plant species. The critical habitats for the two species range from approximately 120-300 m (400-1000 ft) inland from the coastline as shown on Figure 2-2. One population of the endangered sand dune tetramolopium established by the National Park Service was encountered during the field investigation.

Two zones of vegetation are present on site. Near the shoreline, the coastal spray zone contains plant communities that are dominated by native plants. Dominant species include naupaka kahakai (*Scaevola taccada*), beach sandmat (*Chamaesyce degeneri*), and tropical fimbry (*Fimbristylis cymosa*). Further inland, the vegetation transitions to lowland dry/mesic plant communities dominated by invasive species which include Christmasberry (*Schinus terebinthifolicus*), lantana (*Lantana camara*), and sourgrass (*Digitaria insularis*). The predominant native plants were 'ilima 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*), noni (*Morinda citrifolia*), and 'auhuhu (*Tephrosia purpurea*) were occasionally found associate with archeological features (GANDA, 2013).

In addition to the federally and state listed threatened and endangered species, all native Hawaiian plant species are protected and removal is highly restricted. During the RI, special permission was granted to allow cutting native Hawaiian species located outside the coastal spray zone, due to the limited aerial

extent of the transects. It is possible this permission will not be granted for clearance of large site acreage which would provide opportunity for invasive species to establish in place of the native plants.

## 2.1 MAKANALUA BOMBING RANGE MRS

### 2.1.1 Site History

Based on documentation, research, the 2008 SI, and the 2013 RI, the site is confirmed to have been used for aerial bombing, rocket, and strafing training by the US Navy beginning after the acquisition of a 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 a potential unacceptable explosive safety hazard or risk present at the site.

The former MBR site is located within the Kalaupapa National Historic Park, owned by the State of Hawaii and managed by the NPS, State of Hawaii DLNR, and HDOH. It is a significant historical and archaeological place. 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.

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

### 2.1.2 Conceptual Site Model

This section summarizes the CSM developed during the RI for the Range Complex No. 1 – Target Area MRS, presented in Table 2-1. The MEC CSM indicates known or suspected MEC contamination sources, potential/suspected locations and distribution of contamination, current and future receptors potentially complete exposure pathways, and RI fieldwork. As stated earlier, this FS addresses the MEC hazard present in the Target Area. The Remaining Lands, where only expended small arms ammunition were found, is recommended for NDAI and is not addressed in this FS.

The RI risk assessment determined no unacceptable risks were present from MC in either the Target Area or Remaining Lands, and the FS does not address MC. The CSM for MC presented in Figure 2-1 depicts the evaluated MC contaminant migration and exposure pathways for the various receptors.

#### 2.1.2.1 Current and 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 DLNR, and HDOH. There has been no recent development in the Kalaupapa Settlement or with in the vicinity of the park. It is a significant historical, biological, and archaeological place. Numerous archaeological sites are located throughout the entire site. No future development of the site is planned. Public access to the MRS is heavily restricted; however, via permit and escort, visitors can access the area. A dirt road leads through the center of the MRS. The nearby Kalaupapa Settlement preserves the only intact historic institutional settlement in the United States created for the sole purpose of isolating Hansen's disease (leprosy) patients from the rest of society. The site is still actively serving the Hansen's patients who have elected to remain at the site and will continue to do so as long as patient care is needed. Until that time the HDOH will continue to provide oversight to the management of the park.

A park GMP is currently in development by the NPS to address park management after the withdrawal of HDOH patient care, and anticipated future increased tourism pressure. The recent canonization of Father Damien and Mother Marianne, past ministers and caregivers to the resident patients, is raising awareness

of the site and potentially will bring more tourists to the area. These concerns, among others, are being addressed in the GMP alternatives.

The alternatives presented in the NPS GMP under development include varying levels of visitor controls, all are highly restrictive. The least restrictive of the options could involve camping limited to restricted areas and unescorted visitor access on selected trails. This FS will conservatively consider aspects of the least restrictive alternative as a guide to the future uses of the site. This scenario allows visitors access to a trail that follows the coastline and enters into the northeast area of the Range Complex No. 1 Target Area MRS. A dirt road runs through the center of the MRS from the lighthouse to the Kahauko volcano. Current plans do not allow access to this trail, but it is accessed by park personnel.

**Table 2-1: Revised MEC Conceptual Site Model Summary**

| 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**<br><br>Acreage [1]: 232.84 (land)<br><br>Suspected Past DoD Activities (*release mechanisms*): Target Area for Bombing and Rocket Range<br><br>Current and Future Land Use: Recreational | Practice Bombs (AN-Mk5, AN-Mk23, AN-Mk43, AN-Mk19) with signals; Small Arms Ammunition.<br>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.<br>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-ft spacing; 4-ft wide swath, plus investigation of an access transect through the center of the MRS. | Survey and intrusive investigation of 5.51 miles (2.67 acres) of transects | The transect investigation identified a target center. The target was delineated by both UXO and MD findings and MEC density.<br>Note: Per Project Delivery Team (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 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** (Not addressed in this FS)<br><br>Acreage [1]: 599.16 (land)<br>105 (tidal water)<br><br>Suspected Past DoD Activities (*release mechanisms*): Buffer Area for Bombing and Rocket Range<br><br>Current and Future Land Use: Recreational | **Land Area:**<br>None. No UXO or MD was found during the 2008 SI. Only very low densities of expended SAA were found during the 2013 RI. | None. No UXO or MD was found during the 2008 SI. Only very low densities of expended SAA were found during the 2013 RI. | None | Park personnel and recreational users.<br>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-ft spacing. | Survey and intrusive investigation of 11.63 miles (5.64 acres) of transects. | No UXO was found in this area. Only a few expended SAA items found during the 2013 RI. |
| | **Tidal Water Area:**<br>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:<br>1 – RI (2013) | | DoD – Department of Defense<br>MD – Munitions Debris<br>MC – Munitions Constituents<br>MEC – Munitions and Explosives of Concern<br>MRS – Munitions Response Site | | PDT – Project Development Team<br>RI – Remedial Investigation<br>SAA – Small Arms Ammunition |

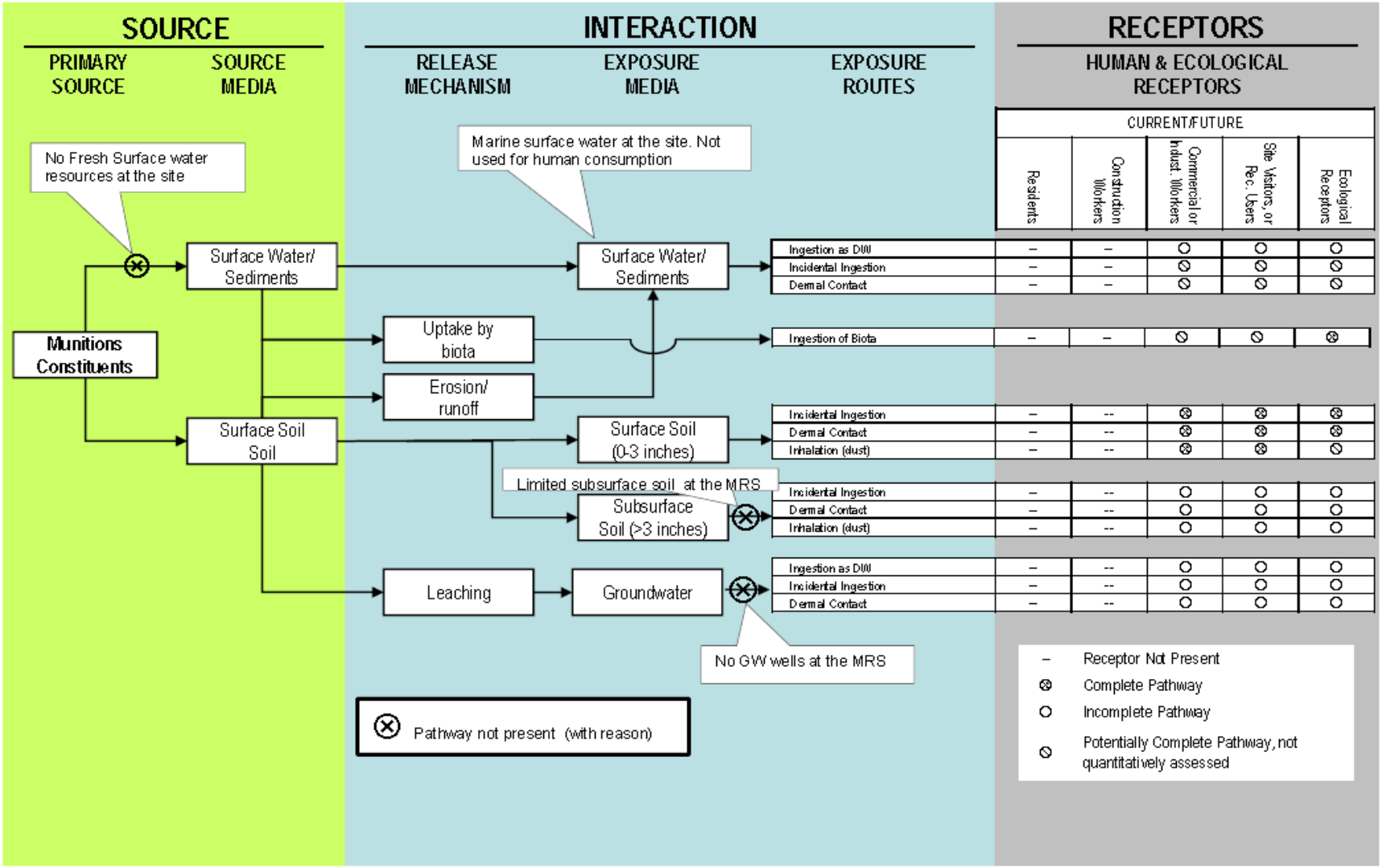


**Figure 2-1: Revised MC Conceptual Site Model for MBR Range Complex No. 1**

### 2.1.3 MEC Characteristics and Distribution

During the 2013 RI 99 UXO items and 1,024 lb of MD were recovered. The UXO and MEC items were distributed over a 232.84-acre target area of land, including the 2.22-acre *heiau* as delineated in Figure 2-2. The target area extended 2.36 acres out of the investigated MRS boundary.

Table 2-2 lists the MEC items known to be present within the MRS based on the results of the 2013 RI Report.

**Table 2-2: MBR MEC Characteristics**

| Size | Nomenclature | Type |
|---|---|---|
| 3 lb. | AN-Mk23 | Practice Bomb |
| 3 lb. | AN-Mk5 | Practice Bomb |
| 4 lb. | AN-Mk43 | Practice Bomb |
| 13 lb. | AN-Mk19 | Practice Bomb |
| .30 and .50 caliber | | Small Arms Ammunition |

#### 2.1.3.1 Potential MEC sources

The practice bombs remaining from past DoD training operations are the source of MEC hazard onsite. No munitions classified as HE have been found. A potential explosive hazard is present for site visitors and park employees who venture into the area and may potentially interact with the UXO items.

Based on RI findings, MEC is located in the Target area delineated in the RI and shown on Figure 2-2.

### 2.1.4 Summary of MC Assessment

The 2013 RI conducted IS of surface soil in three DUs placed in areas of medium to high UXO and MD density. The RI sampling determined 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.

## 2.2 SUMMARY OF MEC HAZARD ASSESSMENTS

#### 2.2.1.1 Baseline Munitions and Explosives of Concern Hazard Assessment

The explosive hazard from UXO at the site, was evaluated using the United States EPA's Munitions and Explosives of Concern Hazard Assessment (MEC HA) methodology (EPA 2008). The results of the MEC HA analysis for the target area of Range Complex No. 1 – Target Area MRS are summarized in Table 2-3. No explosive hazard was identified 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.

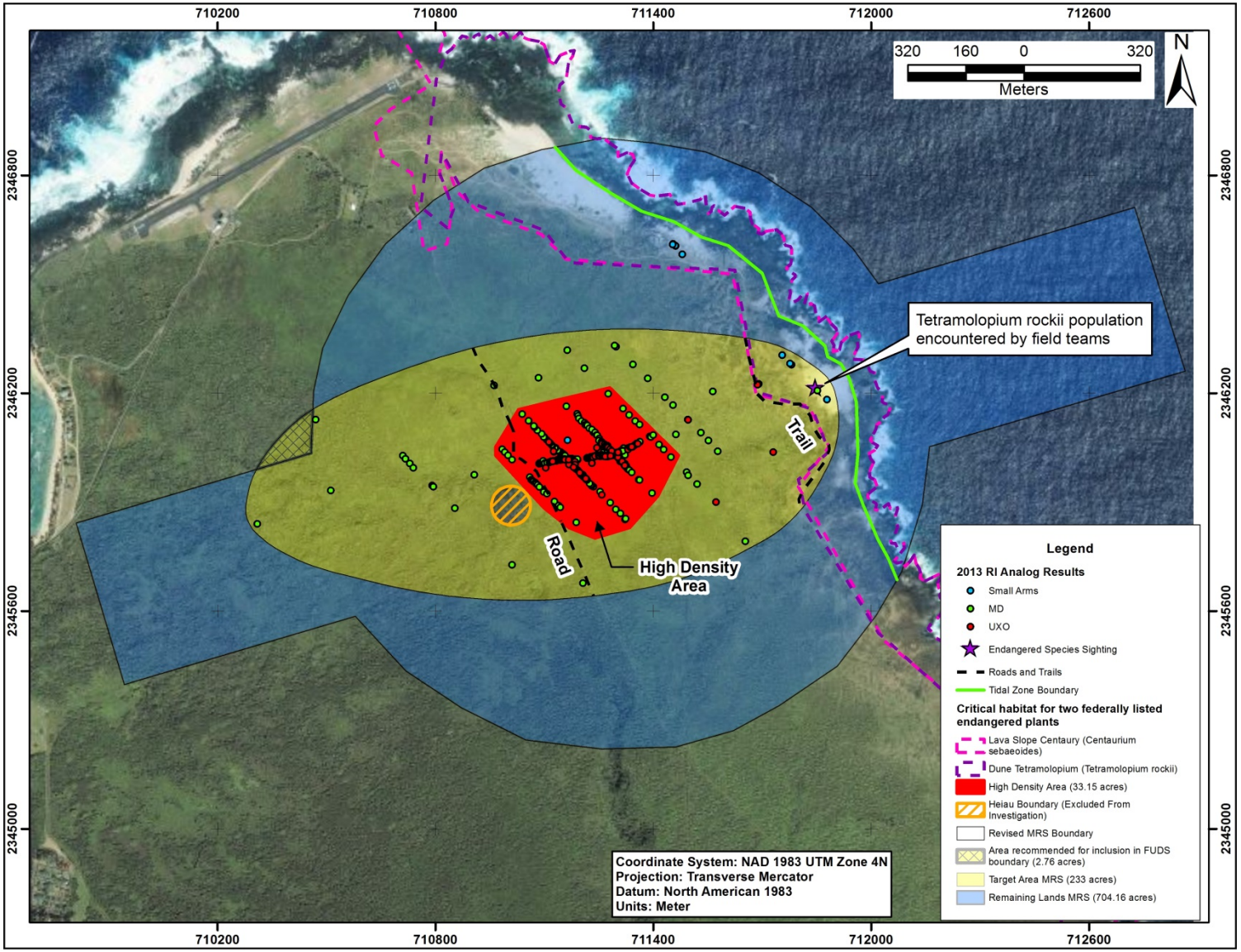


**Figure 2-2: Extent of MEC/MD identified in RI**

**Table 2-3: Baseline 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<br>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.

2.2.1.2 MRSPP Scoring

The Munitions Response Site Prioritization Protocol (MRSPP) scoring tables were completed for the Range Complex No. 1 - Target Area MRS. Scores were completed for the three modules; Explosive Hazard Evaluation (EHE), Chemical Warfare Materiel Hazard Evaluation (CHE), and the Health Hazard Evaluation (HHE). Table 2-4 summarizes the MRSPP scoring. MRSPP Scoring Tables are appended to the 2013 RI Report.

**Table 2-4: 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 |

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

## 2.3 SUMMARY OF MRS INFORMATION FOR ALTERNATIVE EVALUATION AND ESTABLISHMENT OF EXPOSURE AREAS

This section provides details and conclusions for the Range Complex No. 1 – Target Area.

The site is confirmed to have been used for aerial bombing, rocket, and strafing training by the U.S. Navy beginning after acquisition of a permit in 1941 and continuing through October 1946.

The 232.84 acre target area delineated in the 2013 RI Report based on explosive hazard present is the subject of this FS. The 704.16 acres of land and tidal water in the Remaining Lands will not be addressed. No MC hazard is present in either area and will not be addressed.

The former MBR site is located within the Kalaupapa National Historic Park, owned by the State of Hawaii and managed by HDOH, the NPS, and the State of Hawaii DLNR. It is a significant historical and archaeological place and no future development of the site is planned. No intrusive activity is planned other than installation of posts for signage.

The current population of the settlement is around 100 individuals. While the NPS reports that a total of 58,875 visitors visited the Kalaupapa National Historic Park in 2012, the former MBR is not located in a

portion of Kalaupapa Peninsula that is typically visited by the majority of visitors to the park. However, visitors are allowed with permits and escorts.

Potential receptors include residents of the settlement, park personnel, site visitors or recreational users.

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# Chapter 3. IDENTIFICATION AND SCREENING OF RESPONSE ACTIONS

## 3.0 INTRODUCTION

Based on the findings summarized in Chapter 2, this FS is prepared to evaluate the appropriate response actions to address explosive hazards to human health posed by UXO in the form of practice bombs remaining on site. No unacceptable risk to human or ecological receptors was found to be present from exposure to MC remaining on site. The RI report recommended the FS evaluate the appropriate response action that can be implemented at the site to address the UXO hazard present. Based on RI/FS guidance document (USEPA, 1988), and information required by the NCP (40 CFR 300.430 [e]), the FS for the MRS consists of three main phases:

- Developing remedial alternatives.
- Screening the alternatives.
- Conducting a detailed analysis of the alternatives.

The following steps were used in selecting the preferred remedial alternative.

1. Identify the ARARs.
2. Develop the RAOs.
3. Develop and screen GRAs.
4. Identify remedial alternatives.
5. Identify response action areas and select remedial alternatives to be evaluated for each area.
6. Conduct detailed and comparative analysis of alternatives after screening unfeasible actions.
7. Provide enough information for decision makers to identify the appropriate remedial action alternative for the site.

The following sections present steps 1 through 3. Chapter 4 addresses steps 4 and 5; Chapter 5 discusses Steps 6 and 7.

## 3.1 SUMMARY OF ARARS

Section 300.430 (f)(l)(ii)(B) of the NCP states that on-site remedial actions selected in a Record of Decision (ROD) must attain substantive requirements that are identified as 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 DD 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.

### 3.1.1 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.

The RI determined no unacceptable MC risks are present at the former MBR site. No chemical-specific ARARs were identified for the site.

### 3.1.2 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 former 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.

Although only endangered plant species were encountered during fieldwork, federally and state listed endangered plant and animal species have habitats present on site, and it is possible they are both present. The RI did not find a MEC hazard extending into the water, and no alternatives are under consideration that include the water portion of the site. Extensive cutting of vegetation and the disposal of MEC by conventional means could potentially disturb or destroy sensitive species known to be present in the area. The substantive requirements specified in 16 United States Code (USC) 1538(a)(2)(B) require that steps must be taken to mitigate the impacts to endangered species to avoid a take of a protected species.

### 3.1.3 Action-Specific ARARS

Action-specific ARARs are technology- or activity-based requirements that are triggered by the type of remedial action under consideration. 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. No action specific ARARS were identified for this site.

## 3.2 IDENTIFICATION OF SITE-SPECIFIC ARARS

In determining whether a requirement was pertinent to future munitions response actions, potential ARARs were initially screened for applicability. If determined not to be applicable, the requirement was then reviewed for both relevance and appropriateness. Requirements that are considered relevant and appropriate command the same importance as applicable requirements. Table 3-1 summarizes the ARARs and TBC criteria relevant for the former MBR site.

**Table 3-1: Makanalua Bombing Range 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 are present onsite. | 16 USC 1538, (a)(1)(B) Endangered Species Act of 1973 | ARAR Location-specific | Requires protection of T&E species. This ARAR only applies if T&E wildlife is present on site. Note: although none were identified during field operations, habitat is present and it is possible they exist onsite. | 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 are present onsite. | Archaeological Resources Protection Act 16 USC 470 ee (a) | ARAR Location-specific | Prohibits excavation, removal, damage, alteration, or defacement of archaeological resources | Onsite archaeologist to accompany the field team for brush cutting and intrusive activities. |
| Federal | Migratory Birds are known to pass over the area and habitats for some MBTA protected species are present on site. | 16 USC 703(a)Migratory Bird Treaty Act | ARAR Location-specific | Prohibits the taking, possessing, buying, selling, or bartering of any migratory bird, including feathers, or other parts, nest eggs, or products except as allowed by regulations. This includes disturbing nesting birds. | On-site Natural Resource Support (NRS) to accompany field team for brush cutting and intrusive activities to identify habitats for sensitive species and assist in avoidance. |

## 3.3 REMEDIAL ACTION OBJECTIVES

The RAOs describe what remedial actions are designed to accomplish and form the basis for the selection of remedial alternatives.

The RAOs for remedial actions at the Range Complex No. 1 – Target Area MRS are based on the explosive hazard present based on the 2013 RI findings and the following site-specific information:

- The contaminant of interest at the MRS is MEC in the form of UXO from practice bombs with low explosive fragmenting fillers. Based on findings from the 2013 RI, UXO is present on the surface and to a depth of 18 inches.
- The media requiring consideration of potential response action is the surface and subsurface soil of the site.
- The pathways for exposure to UXO are surface activities from visitors and park personnel at the Kalaupapa National Historic Park who venture out of the settlement. Visitors are currently required to have an escort to leave the Settlement.
- The Kalaupapa National Historic Park is a significant cultural place due to the Kalaupapa Settlement and numerous archaeological sites remaining from the native Hawaiians who inhabited the land before relocation at the time the settlement was established. The area has many locations considered sacred that create a special spirit and character to the land. The site is also a significant ecological place due to the presence of threatened and endangered species and sensitive habitats.
- The only intrusive activity anticipated is installation of signage.

Based on these considerations, the following RAOs have been developed for the MRS:

- Reduce potential explosive safety hazards by preventing interaction between receptors (site visitors and park personnel) and intact MEC on the surface.
- Ensure current and future land use is compatible with the option chosen.
- Preserve the historical and spiritual character of the park setting to the maximum extent practicable.
- Protect sensitive biological and archaeological resources to the maximum extent practicable.

## 3.4 PRELIMINARY REMEDIATION GOALS

Preliminary remediation goals are both site and contaminant specific, and define the conditions considered by stakeholders to be protective of human health and the environment. The site closeout statement agreed to by the Technical Project Planning (TPP) Team for the MRS was "To manage the potential munitions, MEC, and MC risk through a combination of remedial action, administrative controls, and public education thereby rendering the site as safe as reasonably possible to humans and the environment, and conducive to the anticipated land use."

The preliminary remediation goal for MEC is to limit interaction between MEC and receptors accessing the MRS. Per the findings of the 2013 RI, no unacceptable risk to human or ecological receptors is present from MC in the MRS; therefore, no Preliminary Remediation Goals (PRGs) are developed for MC.

## 3.5 TARGET RESPONSE AREAS

The acreage within Range Complex No. 1 – Target Area (Figure 1-1) that is the focus of this FS, was established in the 2013 RI to be 232.84 acres and is entirely terrestrial.

## 3.6 GENERAL RESPONSE ACTIONS

The RAOs identified can be achieved through a variety of potential GRAs. USEPA guidance specifies that remedial alternatives are to be developed from applicable remedial technologies and representative process options (USEPA, 1988). This section identifies and screens GRAs, remedial technologies, and process options that are potentially suitable for addressing human exposure to MEC (in the form of UXO) at the MRS. The GRAs can be combined to make up the alternatives to be evaluated at the site.

The GRAs evaluated for Range Complex No. 1 – Target Area MRS (a site with MEC contamination only), are as described below. All options which include MEC removal would treat the MEC to remove the explosive hazard and all Material Documented as Safe (MDAS) is removed and disposed at an off-site facility for smelting and eventual recycling of the resulting metal. Due to the presence of sensitive resources, a Biologist and an Archaeologist would accompany field teams for avoidance of sensitive resources.

- **No Action** – The no action alternative is used solely as a baseline for comparison, as required by the NCP in 40 CFR 300.430(e)(6). The no action alternative assumes that existing signage will be left in place and future maintenance of the signs will be done under current program sources. Therefore, this alternative assumes no additional cost.
- **Land Use Controls (LUCs)** – At FUDS projects, LUCs include engineering controls in addition to institutional controls as discussed in the NCP. LUCs include any type of physical, legal, or administrative mechanism that restricts the use of, or limits access to, real property to prevent or reduce risks to human health, safety, and the environment. LUCs are considered response actions under CERCLA, and must be coordinated with landowners, regulatory agencies, and appropriate local authorities. The objective of LUCs is to ensure the future land use remains compatible with the land use that was the basis for the evaluation, selection, and implementation of the response action. It is preferred that the LUCs be managed and maintained at the local level whenever possible.
- **Long-Term Management - Five Year Reviews** – In accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), and the NCP, remedial actions that do not allow Unlimited Use/Unrestricted Exposure (UU/UE) must be reviewed no less than every 5 years after the remedial action, or more frequently if required by the Record of Decision/Decision Document (ROD/DD). The reviews are conducted to ensure the remedial actions remain protective of human health, safety, and the environment and are considered under LUCs.
- **Surface MEC Removal** – This GRA would involve teams of UXO technicians using visual identification aided by hand held instruments to identify and remove MEC and MD from on the ground surface or partially buried within the Target Area. Varying levels of vegetation removal would be required to support this response action according to location on site. Extensive vegetation removal would be required in some areas.
- **Surface and Subsurface MEC Removal** – This GRA would involve teams of UXO technicians using instruments to identify MEC on the surface and in the subsurface. Each subsurface anomaly is excavated until the source of the anomaly is determined and if a MEC item removed or blown in place. Extensive brush clearing in some areas (primarily in the western portion of the site) would be required to support this alternative. Based on RI findings, MEC is anticipated to be present to a depth of 1.5 ft.
- **Focused Surface MEC Removal and Surface/Subsurface MEC Removal** – This GRA uses a combination of surface MEC removal and subsurface MEC removal to focus the

response action based on anticipated site use and explosive hazard anticipated within sub-areas of the remedial action area.

- **Surface and Subsurface Removal to Support Unlimited Use/Unrestricted Exposure** – This GRA involves teams of UXO technicians removing MEC from the surface and subsurface to a depth of 10 ft or encountering bedrock. Instruments capable of detecting metal are used to identify MEC in the subsurface, with MEC items removed from the surface and subsurface soil, and followed by off-site disposal of MEC recovered. The source of each anomaly is removed. MEC encountered is treated to remove the explosive hazard and all MDAS would be removed and disposed at a facility for smelting. Extensive vegetation removal would be required to support this alternative. Due to the presence of sensitive resources a Biologist and an Archaeologist would accompany field teams for avoidance of sensitive resources. Extensive vegetation removal and soil disturbance would be required in most areas.

For the Range Complex No. 1 MRS- Target Area, all of the GRAs are technically implementable and will be evaluated in an initial screening in the FS.

## 3.7 IDENTIFICATION AND SCREENING OF OPTIONS AND REMEDIAL TECHNOLOGIES

Options to be included in LUCs and potential technologies applicable to the Range Complex No. 1 – Target Area MEC removal were evaluated based on effectiveness, implementability, and cost. Table 3-2 presents and summarizes the screening technologies potentially available for the MRS and provides justification as to whether technologies were discarded or retained for further evaluation.

The evaluation of technologies related to MEC removal included LUCs, detection, removal, and disposal technologies.

### 3.7.1 Land Use Controls

As stated above, LUCs are considered response actions under CERCLA and are coordinated with landowners, regulatory agencies, and local authorities. LUCs are physical, legal, administrative and other mechanisms restricting access and property use. For FUDS sites, where a land use restriction is part of restoration activities, the LUC must be clearly defined, designed and planned, and enforceable. An Institutional Analysis must be performed at all sites that do not allow for unlimited use. The LUCs include engineering controls, in addition to institutional controls, as discussed in the NCP (USACE, 2004). A primary objective of LUCs is to help manage hazards present at the site during the implementation of remedial actions and manage residual hazards after the response is complete. A variety of LUCs can be used in combination to mitigate risks associated with the potential exposure.

The LUCs that are potentially appropriate and considered in the technology screening for the MEC hazard present at former MBR include:

- **Engineering Controls** – Engineering controls either limit the access or the exposure to the hazard that remains onsite.
  - **Fences –** Installation of fencing would be highly effective in controlling access to areas where a MEC hazard is present. However, entry to the park is currently strictly controlled and requires a permit and park escort to venture out of the Kalaupapa settlement. Fencing is likely not necessary due to the remote location, rough seas and rocky shoreline that discourages unauthorized entry by boaters and divers and rugged entry from the south. Fencing would severely interfere with the aesthetics associated with the historical and spiritual ambience and natural beauty of the site. The fencing option will not be explored further.

- **Signage –** Installation of signage installed by NPS is currently in place and is used to guide visitors to accessible areas and away from restricted areas (Figure 3-1). The purpose of the current signage is for historical and cultural protection. Signage provides an opportunity to support the educational controls and give site visitors notification and reinforcement of MEC hazards present with information on the three R's of MEC awareness (Recognize, Retreat, and Report).


**Figure 3-1: NPS signage currently in place as part of existing LUCs for historical and cultural preservation, Kalaupapa National Historic Park**

- **Institutional Controls** – The institutional controls are comprised of Educational Controls and Legal and Administrative Controls.
  - **Educational Controls** – The focus of education would be targeted to site visitors and park personnel, the receptors most likely to be venturing into the areas of the Park with the MEC hazard present. The educational controls would be comprised of:
    - Public notification through a site orientation program when obtaining visitor permits. This would be accomplished by adding a MEC Hazard component to the site visitor orientation to include verbal instruction and distributing Fact Sheets to provide site users with awareness of potential UXO hazards present and an opportunity to emphasize the three R's of MEC awareness (Recognize, Retreat, and Report).
    - A MEC hazard component to employee orientation for HDOH and park personnel. Through an initial orientation and posters in areas where employees congregate, the employees would be informed and prepared to educate visitors of the MEC hazard present.
- **Legal and Administrative Controls** - Due to the historical nature of the site, no significant future development is planned or likely to occur in the future. The only intrusive activity anticipated is installation of potential new signage.
  - **Legal Controls –** Further controls would ensure land use designations continue after the HDOH withdraws involvement at the site, and the land use controls are re-examined. An institutional analysis detailing the institutions with involvement at the site is found in Appendix D. The park GMP (currently in development) will likely continue to limit activities. It is preferred LUCs should be managed and maintained at the local level where possible (USACE, 2004). Appending an existing Institutional Control Plan rather than creating a new institutional control vehicle provides better coordination and management of resources and will provide assurance that plans are maintained long term. Putting a LUC program in place by appending the Kalaupapa Historic Park GMP would be a sensible way to manage and coordinate restriction to areas where visitors have access, and place and maintain a restriction on intrusive activities.

  - **Administrative Controls –**Strict land restrictions are currently in place at the site to support the site historical designations and provide privacy to resident patients.

- **Five Year Reviews –** In accordance with CERCLA, response actions that do not allow unlimited use and unrestricted exposure must be reviewed no less than every 5 years after the start of the response action, or more frequently if required by the ROD/DD. The reviews are conducted to ensure that the response actions remain protective of human health, safety, and the environment. Scoping and developing five-year review requirements will be part of the RD phase.

### 3.7.2 Detection Technology

The detection technologies considered at the site include Analog hand-held instruments and Digital Geophysical Mapping (DGM).

#### 3.7.2.1 Analog Metal Detectors

The analog detectors evaluated include Flux-gate technology (such as the Schonstedt 52-Cx) and frequency domain detection technology (such as the Minelab Explorer II).

Both devices are easily transportable and highly useful in uneven terrain. The ease of deploying analog detection instruments allows for higher production rates than that of DGM Instruments due to the size of equipment and the level of effort to deploy. The depth of detection is less than DGM methods and both require more costs related to QC seeding to deliver high confidence levels. In the RI, the error associated with reacquisition was handled by 100% clearance of anomalies detected, with the intrusive work conducted concurrent with detection operations.

The flux gate device (Schonstedt 52-Cx) measures the vertical component of the geomagnetic field along the axis of the sensor and not the total geomagnetic field. It is best for detecting small, shallow items, and is only capable of detecting ferrous objects. It delivers a high number of false positive detections in geographic locations with a high iron content in the soil and bedrock such as the former MBR site. This technology will not be evaluated in the FS due to the high iron levels present from the igneous origins of the site.

The frequency domain devices (Minelab Explorer II) use an electromagnetic induction technology to generate one or more defined frequencies in a continuous mode of operation. This gives it the capability of detecting all metals (not just ferrous metals) and operating effectively in iron rich soils. The device has proven to be successful in the predominantly shallow soils present onsite at MBR. The Minelab Explorer II was successfully used during the RI investigation.

#### 3.7.2.2 Digital Geophysical Mapping

The time domain electromagnetic induction technology (such as the Geonics EM61 MK2) associated with DGM delivers high confidence level data to a greater depth than analog instruments. However, the surface soil at the site is shallow in most areas and no items were found deeper than 1.5 ft in the 2013 RI. This technology requires processing of data, followed by a return for reacquisition of the selected anomalies, prior to intrusive work.

DGM technology allows for higher confidence levels (and QC) than that of analog technology. The technology can be used on various platform configurations (man or mechanically pulled cart, towed array "stretcher mode", and airborne). At former MBR, if the technology was used, stretcher mode deployment would be required, which requires additional personnel. Due to the highly irregular, rocky surface of the former MBR site, this technology will not be explored further.

#### 3.7.2.3 Innovative Technologies

Several innovative technologies related to advanced digital geophysical sensors have been developed in recent years. By measuring multiple components of the electromagnetic field along three axes these sensors produce data which can more effectively differentiate between MEC items and other debris. The Metal Mapper, TEMTADS, and Berkley UXO Detector (BUD) are examples of these advanced sensors. These sensors have been used at demonstration projects across the country and have been very successful; however, their use is still in the research stage and equipment is not readily available.

At many sites, effective use of these sensors could potentially eliminate a significant number of excavations and reduce the cost of remediating a MRS. These methods are particularly applicable to areas where the range of expected munitions is limited, and a large amount of non-munitions related debris is present. Almost all anomalies detected in the 2013 RI were munitions related.

While advanced electromagnetic instruments show significant potential to make subsurface MEC removal more cost effective, their use has not yet been fully accepted by environmental regulators. Due to the lack of full regulatory agency acceptance of these sensors, the highly irregular topography of the site, the high costs related to site logistics, and the fact very few non munitions related anomalies were found at the site during the RI, this technology will not be evaluated as a remedial alternative in this FS.

### 3.7.3 Removal Technology

Removal technologies include hand excavation and mass excavation with sifting (using mechanical equipment). Mechanical excavation is generally more suitable for high concentrations of munitions extending to greater depths. The mechanical equipment causes an extremely high level of disturbance to the land. Due to the presence of uneven terrain and sensitive biological and archaeological resources, the use of mechanical equipment for mass excavation is not considered viable.

Hand excavation is considered the industry standard for UXO recovery and can be done very thoroughly and effectively. Hand excavation was conducted during the RI. Cost for implementing hand excavation operations is expensive, but considered the best option due to the uneven terrain and presence of sensitive ecological and cultural resources.

### 3.7.4 Disposal Technology

Disposal technologies considered include Blow in Place (BIP), “consolidate and blow”, and a Thermal Treatment Unit (TTU). For all disposal options, the resulting MDAS is shipped off site to be shredded or smelted in order to prevent the MD from being encountered again as suspected MEC.

#### 3.7.4.1 Blow-in-Place

For BIP, each munition is individually destroyed at the location it was found by placing detonation charges or other explosive materials on the munitions. As a result of detonating munitions, MC may potentially remain at the site of the detonation. If residual MC is present in high enough concentrations, it can pose an explosive hazard and may pose a risk to human and/or ecological receptors. Collection of post-detonation soil samples would be required for analysis. Should the analysis show that an unacceptable level of MC is present; the detonation location may be subject to a remedial action.

Conducting BIP operations would require the delivery of explosives (by air or sea vessel) which is complicated by the remote site location. Individual shots use explosives less efficiently than the “consolidate and blow” option, and are manpower intensive.

#### 3.7.4.2 Consolidate and Blow

The consolidated shot can be used only for munitions that are “acceptable to move.” This option can make more efficient use of explosives and manpower than the BIP method. Additionally, the location for

the shot can be placed at a spot away from sensitive resources. However, unless the munitions are found the same day, a guard will need to be in place until demolition can occur. The operations require a larger area than the BIP operations and potential kick-out of UXO fuzes, boosters, and bursters presents a secondary hazard. As with BIP operations, MC may potentially remain at the site of the detonation.

The same logistical challenges for explosives noted in BIP would apply to this technology.

No items were found during the RI that were unacceptable to move. Collection of post-detonation samples would be required.

3.7.4.3 Thermal Treatment Unit

The TTU technology uses thermal treatment to remove the explosive hazard from UXO items. Using the TTU avoids the transportation and hazards associated with donor explosives, eliminates the need for post-detonation sampling, and is less destructive to the sensitive biological and archaeological resources. All RI UXO items found were destroyed thermally in a Batch Burner Furnace TTU. This option is available only if items are safe to move, and meet the net explosive weight limitations of the TTU. However, all UXO items found during the 2013 RI were deemed safe to move and met the limitations of the TTU. The TTU is expensive to rent and requires fuel (propane) to be transported to the site. Figure 3-2 is a photo of the TTU successfully used in the RI investigation. In cases where acceptable to use, this will be the preferred option for removing the explosive hazard from MEC.

**Figure 3-2: Thermal Treatment Unit**

**Table 3-2: Technology Screening Summary**

| General Response Action/ Technology | Process Option | | Description | Effectiveness | Implementable | Cost | Consider Further | Rationale |
|---|---|---|---|---|---|---|---|---|
| Land Use Controls | Engineering Controls | Signage | Provide awareness of the UXO hazard present and guidance on accessible areas, restrictions on intrusive activities, and opportunity to emphasize procedures if site users encounter UXO, 3 R's (recognize, retreat, and report). | Moderately High | Yes | Low | Yes | Highly effective approach to mitigate exposure if written in the language of the reader. Signage reminding visitors of the explosive hazards are appropriate. Only effective is visitors can understand the message of the sign and modify their behavior to follow the guidance. |
| | | Fencing | Fences limit access. | High | Yes | High | No | Likely not necessary due to the site remoteness, limited access, and high cost. Would negatively impact the aesthetics associated with the historical and spiritual ambience and natural beauty of the site. |
| | Institutional Controls | Educational Controls | Provides site users and park employees with awareness of potential UXO hazards. | High | Yes | Low | Yes | Due to the historical nature of the site and the highly restricted residential community that is not expected to grow, educational awareness would be oriented to visitors and park personnel. Provides opportunity to emphasize MEC awareness. |
| | | Legal Controls | Controls on the land to limit land use to non-intrusive activities and provide a mechanism to ensure long-term enforcement of the controls. | High | Yes | Low | Yes | New restrictions are likely not necessary at this site, as the site is owned by the state and managed by HDOH and the National Park service. It is part of a significant historical area, and no future development is planned. However, a management change is likely in the future and legal controls may be necessary for long-term protection. |
| | | Administrative Controls | Visitor Permits | High | Yes | Low | Yes | Visitors that leave the Kalaupapa Settlement are currently required to obtain a permit and required to have a park escort. |
| | | | 5-year Reviews | High | Yes | Low | Yes | Required by CERCLA for all options that do not provide allow unlimited use and unrestricted exposure. Ensures LUCs are being implemented and monitored. Provides an opportunity to review and modify the LUCs if necessary. |
| Detection Technology | Analog | | Handheld flux gate magnetometer Sensor similar to a Schonstedt 52-DX. | Medium<br>Have been used as the primary detector in traditional "mag and flag" and "mag and dig operations".<br>High industry familiarization. Only detects ferrous objects. | High<br>Light and compact. Can be used in any traversable terrain. Widely available from a variety of Sources | Lower than average in most terrain | No | Not effective at this site due to igneous character of the geology and high iron content of the soil. Detects ferrous items only. |
| | | | Hand Held Frequency Domain EMI Sensor similar to Minelab Explorer II. | Medium<br>High industry familiarization. Detects both ferrous and non-ferrous objects. | High<br>Hand held, light and compact. Can be used in any traversable terrain. Widely available from a variety of Sources | Lower than average cost in typical terrain. | Yes | Used successfully during the MBR RI activities. An all metals detector that is less susceptible to interferences from iron content in soil. Depth of detection is less than the EM 61, but there is only evidence of practice bombs onsite and soils are predominantly shallow. Would require more QC seeds. Anomalies would be intrusively investigated concurrent with detection. |

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**Table 3-2 Technology Screening Summary (continued)**

| General Response Action/ Technology | Process Option | Description | Effectiveness | Implementable | Cost | Consider Further | Rationale |
|---|---|---|---|---|---|---|---|
| Detection Technology | Digital Geophysical Mapping | Time domain sensor used to identify and reacquire anomalies similar to Geonics EM 61-MK2. | Standard detector for EM. High industry familiarization. Detects ferrous and non-ferrous metallic objects. | High: Typically utilizes 1 m wide by 0.5 m or 1 m for transmitter and receiver coils, but alternate sizes are available. Can be used in most traversable terrain. Most commonly used instrument is widely available. Processing and interpretation are relatively straightforward. | Average in typical terrain. Below average when arrays of multiple detector are used. | No | Less productive than analog method. Requires data analysis, followed by anomaly reacquisition, prior to intrusive work. Would require more man power. More destructive to environment than analog methods. The rocky nature of the MBR site was not appropriate for this technology. These devices have shown promise in discriminating between items likely to be MEC and cultural debris. However, the technology is not fully accepted by regulators, and would not be warranted at this site. Very little cultural debris was found during the RI and discrimination may not be necessary. The extreme rocky nature of the MBR site limits use of this technology. |
| | | Innovative Technology similar to Metal Mapper, TEMTADS, and Berkley UXO Detector (BUD) | High Detects both ferrous and non-ferrous metallic objects. | Man portable versions available. | High | No | These devices have shown promise in discriminating between items likely to be MEC and cultural debris. However, the technology is not fully accepted by regulators, and would not be warranted at this site. Very little cultural debris was found during the RI and discrimination may not be necessary. The extreme rocky nature of the MBR site limits use of this technology. |
| Removal Technology | Manual | Anomalies removed with hand tools. Method allows for close visual identification during removal. | High | Yes | Moderate | Yes | Allows for close visual inspection during removal, least destructive of site. Reasonable costs. |
| | Mechanical/Sifting | Heavy machinery used for anomaly removal, followed by manual sifting of soil. | High | Yes | High | No | This technology is highly destructive and sensitive biological and archaeological resources are present at the site. Expensive mobilization costs for equipment. |
| Disposal Technology | Blow-in-Place (BIP) | Detonation of MEC item at location found with no movement by personnel once deemed unsafe to move. Potentially destructive of sensitive resources. | High | Yes | High | Yes, only if MEC can't be moved. | May be needed for MEC items deemed unsafe to move. However, all RI items were practice bombs and were transportable. If necessary, mitigation will be used to lessen impacts to extent practicable. MC Sampling necessary for residual explosives in soil. |
| | Consolidated Shot | Multiple MEC items detonated at one location with one explosive shot. Only applicable if item is deemed acceptable to move. Location for demolition can be chosen for no impact to sensitive resources. Less explosives required than for BIP as donor explosives shared for items. | High | Yes | Moderate | Yes, only if MEC can be moved. | Reduces production downtime and amount of explosives needed. Only applicable for items safe to move. Will only be used if unexpected munitions are encountered. If necessary, mitigation will be used to lessen impacts to extent practicable. MC Sampling necessary for residual explosives in soil. |
| | Thermal Treatment | Thermal treatment in a batch burner furnace. | High | Yes | High | Yes | Applicable only to items deemed safe to move. Limited to 0.2 lbs TNT equivalent NEW per batch. Applicable for all findings from RI, and those anticipated to be onsite. Expensive to transport onsite. No MC sampling necessary. Highly protective of environment. High transportation costs for TTU and fuel. |

# Chapter 4. DEVELOPMENT AND SCREENING OF ALTERNATIVES

## 4.0 INTRODUCTION

The GRAs were developed in accordance with USEPA guidance (USEPA, 1988), by combining the remedial technologies and representative process options that were identified in Sections 3.5 and 3.6. The objective of alternatives development is to provide an appropriate range of remedial alternatives and sufficient information with which to adequately analyze and make comparisons.

In accordance with the latest DERP Guidance (DoD, 2012) alternatives assembled for FS evaluation include, at a minimum, the following:

- A no action alternative.
- An alternative with an action to remediate the site to a condition that allows UU/UE condition.
- An alternative with an action to remediate the site to a protective condition that requires land use restrictions.

The remedial alternatives for former MBR are designed to reduce the overall hazards associated with MEC present onsite. The alternatives are described in the following sections in terms of their objectives and anticipated implementation measures and maintenance activities. General assumptions for each alternative are provided in this section. Additional assumptions related to cost estimates are included in Appendix C.

The MEC process options were combined into the following generalized remedial alternatives:

- No Action.
- LUCs Only.
- LUCs and Surface MEC Removal.
- Surface and Subsurface MEC Removal. Two alternatives were considered for surface and subsurface MEC removal, one to depth of detection protective of human health, but which would require LUCs; and one with MEC removal to a depth that would allow unlimited, unrestricted use of the property.

An appropriate range of the generalized remedial alternatives are selected for the site and described in Section 4.1. Table 4-1 provides a summary of the remedial alternatives selected for MBR and Figure 4-1 shows the areas addressed in the various alternatives.

## 4.1 REMEDIAL ALTERNATIVES

This section provides a brief description of each alternative; further detail is provided in Chapter 5.

### 4.1.1 Alternative -1 – No Action

Under the no action remedial alternative, the current conditions at the Range Complex No. 1 Target Area MRS would remain unchanged. The site would remain unfenced and under the control of the NPS and HDOH. The current regulations in place that limit the number of visitors in the park, and require a permit for park access would remain unchanged. The visitors would gain access to the MRS through Park personnel and be required to obtain a permit. However, the NPS is currently exploring future management alternatives that could potentially allow visitors more access. No action would be taken to reduce the known MEC hazard. No cost is assumed for this alternative. The No Action GRA does not adequately meet the RAOs and is used solely for comparison, as required by the NCP in 40 CFR 300.430(e)(6)40 CFR 300.430(e)(6).

**Table 4-1: Summary of Remedial Alternatives**

| Alternative | Description of Alternative | Land Use Controls | | | | Detection | MEC Removal | | Disposal | Under Further Consideration |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Engineering Controls - Signage | Educational Controls | Legal Controls | Administrative Controls | Analog | Surface | Sub-surface | TTU, supported by BIP or consolidated shot if needed | |
| 1 – No Action | No action taken. | No | No | None new | None new | None | No | No | No | Yes |
| 2 – LUCs | Signage, Access restrictions, Land Use limited to non-intrusive activities, 5-year reviews. | Yes | Yes | Yes | Yes | None | No | No | No | Yes |
| 3 –Surface MEC Removal of entire Target Area MRS | Surface MEC Removal within Target Area MRS (233 acres); LUCs and 5-year reviews. | Yes | Yes | Yes | Yes | Analog Minelab II | Yes | No | Yes | Yes |
| 4 –Surface MEC Removal (trail, dirt road, and high MEC density area) | Surface MEC Removal plus 25 ft either side along trail and dirt road within Target Area, and high MEC density area (37.74 acres total); LUCs and 5-year reviews. | Yes | Yes | Yes | Yes | Analog Minelab II | Yes, Partial | No | Yes | Yes |
| 5 –Surface MEC Removal (trail, dirt road) and Surface/Subsurface MEC Removal (high MEC density area) | Surface MEC Removal (trail and dirt road; 4.59 acres) and Surface/Subsurface Removal (high MEC density area, 33.15 acres); LUCs and 5-year reviews. | Yes | Yes | Yes | Yes | Analog Minelab II | Yes, Partial | Yes, Partial | Yes | Yes |
| 6 –Surface/Subsurface MEC Removal (trail, dirt road, and high MEC density area) | Focused surface/subsurface MEC removal of trail, road, and high MEC density area (37.74 acres total) LUCs and 5-year reviews. | Yes | Yes | Yes | Yes | Analog Minelab II | Yes, Partial | Yes, Partial | Yes | Yes |
| 7 – Surface/Subsurface MEC Removal of entire Target Area MRS to unlimited use/unrestricted exposure | Full Surface and subsurface MEC removal within the Target Area (233 acres) to 10 ft or bedrock, whichever is encountered first. | No | No | No | No | Analog Minelab II | Yes | Yes | Yes | No |

Note: LUCs considered here are in addition to the LUCs already in place for historical/archaeological purposes.

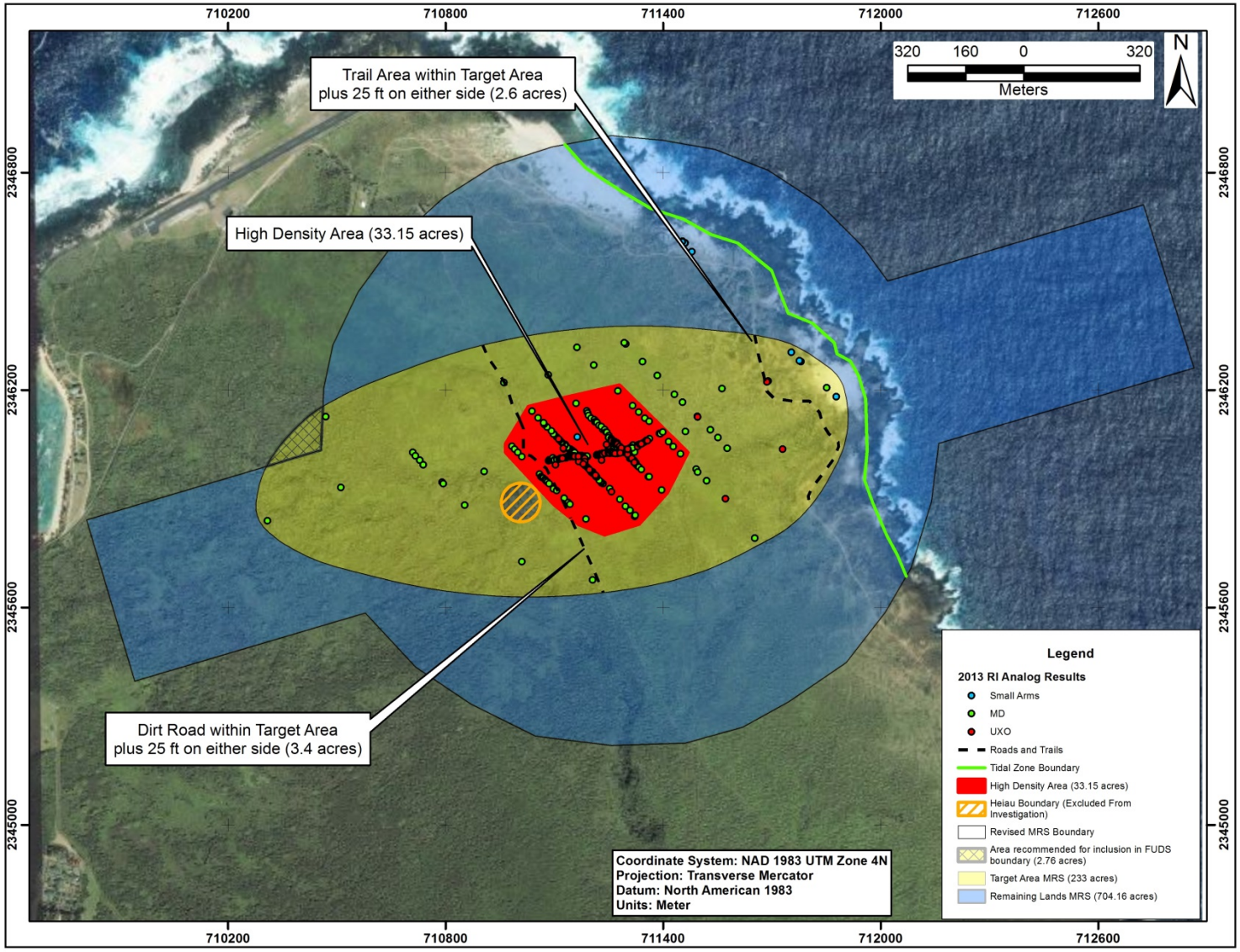


**Figure 4-1: Potential MEC Removal Areas**

### 4.1.2 Alternative 2 – Land Use Controls

For Alternative – 2 only Land Use Controls accompanied by 5-year reviews would be implemented.

This alternative would include restrictions on the land to ensure use is restricted to spiritual, recreational, and research uses only and no intrusive activity is conducted within the Range Complex No. 1 Target Area. Due to the historical nature of the site, the presence of sensitive biological and archaeological resources, land restrictions are already be in place. The NPS is currently considering options for the future use of the site when the HDOH withdraws involvement with management. Even the least restrictive alternative under consideration imposes strict controls of the site (NPS, 2011).

Engineering controls suitable for the site include signage placed at strategic locations throughout the site, preferably attached to existing signage when possible to retain the natural and historical nature of the site.

This alternative would also include educational controls, which would involve a formal briefing of all new park personnel and others at the site on the nature of the hazards present. Park personnel would also receive training (with annual refreshers) on how to educate the site visitors regarding explosive hazards present. Visitors would be provided MEC hazard awareness upon receipt of their permit. Signage would be installed to provide hazard awareness and include information on the "3 R's" (Recognize, Retreat, Report) to reinforce how to respond if a UXO item is encountered on site.

LUCs would be supported by preparation of a Land Use Control Implementation Plan (LUCIP). The LUCIP would provide specific details on all institutional controls established for the site. Five year reviews would be included as part of the LUCIP to monitor the effectiveness of the LUCs, and provide an opportunity for revision if necessary. It is possible the reviews may occur at shorter intervals if changes occur that affect the current land use controls significantly.

In addition to LUCs considered as an alternative in its own right, they will be considered as part of any alternative that doesn't provide a full removal of MEC hazard that supports unlimited use/unrestricted exposure.

### 4.1.3 Alternative 3 –Surface MEC Removal within entire Target Area, LUCs

This alternative will include a surface removal of MEC and MD from the entire 233 acre target area, plus LUCs accompanied by 5-year reviews. All MEC located on the surface and partially buried would be cleared by visual detection supported by the handheld metal detectors in areas of vegetation accumulation. LUCs would be put in place to ensure no intrusive activities would be conducted by site users. The only onsite intrusive activity based on anticipated future site use would involve installation of signage. A large portion of the site would need to be cleared of vegetation, but potentially less than for a subsurface investigation. All MEC and MD would be located using hand held detectors, and removed using hand tools.

A field Biologist and an Archaeologist would accompany the field crew to provide guidance to avoid damage to sensitive habitats during fieldwork. MEC items deemed safe to move and meeting the conditions of the TTU would be thermally destroyed. All munitions found during the 2013 RI met the requirements of the TTU, and based on this fact, future demolitions are not anticipated. The resulting MDAS would be sent to a smelter to remove any resemblance to munitions and then sent to a metals recycler.

### 4.1.4 Alternative 4 –Surface MEC Removal along Trail and Dirt Road within Target Area, and High MEC Density Area; LUCs

Alternative 4 includes a surface MEC removal of all MEC and MD on the surface and partially buried along and 25 ft either side of both the dirt road that runs through the center of the area (3.4 acres) and the

trail along the shore line (2.6 acres), the high MEC density area (33.15 acres), plus LUCs accompanied by 5-year reviews. The total acreage receiving surface MEC removal is 37.74 acres, which accounts for the overlap portion of the dirt road that runs through the high MEC density area. A surface clearance of the trail near the shoreline was conducted during the RI, and this area would primarily involve the 25 ft on either side of the trail. All MEC and MD would be located using hand held detectors. LUCs would be put in place to ensure no intrusive activities would be conducted by site users. The only onsite intrusive activity based on anticipated future site use would involve installation of signage.

A field Biologist and an Archaeologist would accompany the team to provide guidance in imposing the least damage to sensitive habitats. MEC items deemed safe to move and meeting the conditions of the TTU would be thermally destroyed. All munitions found during the 2013 RI met the requirements of the TTU, and based on this fact, future demolitions are not anticipated. The resulting MDAS would be sent to a smelter to remove any resemblance to munitions and then sent to a metals recycler.

Alternative 4 would cause some destruction of site vegetation. However, it provides a high level of protection in areas that are likely to be used by visitors, and where the highest concentration of MEC is anticipated. Some MEC would likely remain onsite in the subsurface soil, but visitors and site users would not be conducting intrusive activities to interact with it.

### 4.1.5 Alternative 5 – Surface MEC Removal along Trail and Dirt Road within Target Area and Surface / Subsurface Removal of High MEC Density Area; LUCs

Alternative 5 includes surface MEC removal of the road and trail and surface/subsurface MEC removal of the high MEC density area, plus LUCs accompanied by 5-year reviews. The total acreage receiving surface MEC removal is 4.59 acres (which accounts for the overlap portion of the dirt road that runs through the high MEC density area); the total receiving surface/subsurface MEC removal is 33.15 ac.

All MEC and MD would be located using hand held detectors, and removed using hand tools. The designated subsurface areas would be cleared to 2.0 ft. LUCs would be put in place to ensure no intrusive activities would be conducted by site users. The only onsite intrusive activity based on anticipated future site use would involve installation of signage.

A field Biologist and an Archaeologist would accompany the field team to provide guidance in reducing damage to sensitive areas. All MEC and MD items found would be removed from the site surface. MEC items deemed safe to move and meeting the conditions of the TTU would be thermally destroyed. All munitions found during the RI met the requirements of the TTU, and based on this fact, future demolitions are not anticipated. The resulting MDAS would be sent to a smelter to remove any resemblance to munitions and then sent to a metals recycler.

Alternative 5 would cause some destruction of the site vegetation. However, it provides a high level of protection in areas that are likely to be used by visitors, and removes the majority of MEC anticipated to be onsite.

### 4.1.6 Alternative 6 –Surface / Subsurface MEC Removal along Road and Trail within Target Area, and High MEC Density Area; LUCs

Alternative 6 includes a focused Surface/Subsurface MEC removal of the road and trail within the Target Area, and in the high MEC density area. The total acreage receiving surface/subsurface MEC removal is 37.74 acres, which accounts for the overlap portion of the dirt road that runs through the high MEC density area. This alternative would also require LUCs accompanied by 5-year reviews. All MEC and MD would be located using hand held detectors, and removed using hand tools. The designated subsurface areas would be cleared to 2.0 ft. LUCs would be put in place to ensure no intrusive activities would be conducted by site users. The only on-site intrusive activity based on anticipated future site use would involve installation of signage.

A field Biologist and an Archaeologist would accompany the field team to provide guidance in reducing damage to sensitive areas. All MEC and MD items found would be removed from the site surface. MEC items deemed safe to move and meeting the conditions of the TTU would be thermally destroyed. All munitions found during the RI met the requirements of the TTU, and based on this fact, future demolitions are not anticipated. The resulting MDAS would be sent to a smelter to remove any resemblance to munitions and then sent to a metals recycler.

Alternative 6 would cause some destruction of the site vegetation. This alternative does not provide protection to site visitors in the areas where they have access to, however it removes the majority of MEC anticipated to be onsite.

### 4.1.7 Alternative 7 –Full Surface / Subsurface MEC Removal to Support Unlimited Use/ Unrestricted Exposure

Alternative 7 includes a full Surface/Subsurface MEC removal throughout the Target Area (233 acres). All MEC and MD would be located using hand held detectors, and removed using hand tools. The subsurface areas would be cleared to 10 ft or bedrock which ever was encountered first. No LUCs or 5-year reviews would be required.

A field Biologist and an Archaeologist would accompany the field team to provide guidance in reducing damage to sensitive areas. All MEC and MD items found would be removed from the site. MEC items deemed safe to move and meeting the conditions of the TTU would be thermally destroyed All munitions found during the RI met the requirements of the TTU, and based on this fact, future demolitions are not anticipated. The resulting MDAS would be sent to a smelter to remove any resemblance to munitions and then sent to a metals recycler.

Alternative 7 would removes all MEC anticipated to be onsite as technologically feasible, however it would cause an extensive amount of damage to site vegetation, possibly destroying most vegetation onsite. Activities requiring intrusive depths to allow unlimited use/unrestricted exposure are highly unlikely in the future of this site. For this reason, and the highly destructive nature of implementation, the alternative will not be considered further.

# Chapter 5. PROJECT REMEDIAL RESPONSE OBJECTIVES

## 5.0 INTRODUCTION

According to the NCP 40 CFR Part 300, the primary objective of the FS is to "ensure that appropriate remedial alternatives are developed and evaluated." Detailed analyses of the remedial alternatives for the Range Complex No. 1 – Target Area MRS have been conducted using the standard criteria specified in the Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, 1988). These alternatives meet the HDOH HEER requirements for a RAA. The CERCLA criteria are described in Section 5.1. In Section5.2, the alternatives presented in Section 4.1 are evaluated individually against the criteria for each response action area. The alternatives are then compared with one another in Section 5.3 The results of this detailed analysis of alternatives will support decision makers in the selection of a remedial action for the site and provide the foundation for the Proposed Plan and DD.

The nine CERCLA evaluation criteria are specified by the USEPA (1988), as follows:

- Criterion 1 – Overall Protection of Human Health and the Environment.
- Criterion 2 – Compliance with ARARs.
- Criterion 3 – Long-Term Effectiveness and Permanence.
- Criterion 4 – Reduction of Mobility, Toxicity, or Volume through Treatment.
- Criterion 5 – Short-Term Effectiveness.
- Criterion 6 – Implementability.
- Criterion 7 – Cost.
- Criterion 8 – State Acceptance.
- Criterion 9 – Community Acceptance.

The NCP 40 CFR Section 300.430(e)(9)(iii) categorizes these nine criteria into the following three groups, each with its own weight.

- Threshold Criteria.
- Balancing Criteria.
- Modifying Criteria.

The three NCP groups and the associated nine CERCLA criterion are described below. Table 5-1 correlates the nine criteria to the three groups.

***Threshold Criteria***

Threshold criteria are requirements that each alternative must meet to be eligible for selection as the preferred alternative. There is little flexibility in meeting the threshold criteria; the alternative must meet them or it is unacceptable. The threshold criteria consist of Criterion 1, overall protection of human health and the environment, and Criterion 2, compliance with ARARs (unless a waiver is obtained).

***Balancing Criteria (Technical Criteria)***

Balancing criteria are used to form the basis for comparison among alternatives that meet the threshold criteria. The balancing criteria group consists of Criteria 3 through 7, which are the main technical criteria used in the detailed evaluation and comparative analysis of the alternatives.

***Modifying Criteria (Acceptance)***

Modifying criteria consist of Criteria 8 and 9, state/agency acceptance and community acceptance, respectively. These criteria may be used to modify aspects of the preferred alternative when preparing the DD. Modifying criteria are generally evaluated after public comment on the RI/FS Report and the Proposed Plan and therefore will not be addressed in the FS.

**Table 5-1: Nine Criteria for Detailed Analysis of Alternatives**

| Group | Criteria |
|---|---|
| Threshold Criteria | 1. Overall Protection of Human Health and the Environment<br>2. Compliance with ARARs |
| Balancing Criteria | 3. Long-Term Effectiveness and Permanence<br>4. Reduction of Mobility, Toxicity, or Volume through Treatment<br>5. Short-Term Effectiveness<br>6. Implementability<br>7. Cost |
| Modifying Criteria | 8. State Acceptance<br>9. Community Acceptance |

## 5.1 DESCRIPTION OF EVALUATION CRITERIA

The following sections describe the nine evaluation criteria.

### 5.1.1 Criterion 1 - Overall Protection of Human Health and the Environment

This criterion is used to assess if each alternative provides and maintains adequate protection of human health and the environment. The alternatives are assessed to determine if they can adequately provide protection from unacceptable MEC hazards from the UXO present onsite. For protection of human health, evaluation was viewed through the potential exposure pathway between MEC and receptor. Exposure to a MEC hazard involves three components: a receptor, a MEC source, and interaction between the two. All three components are to be considered in evaluating the level of protectiveness required.

The protectiveness is also evaluated to consider if the RAOs are achieved, if removal depths support land use assumption of the RAOs. For the former MBR the environmental impact from implementation of the alternative is a major issue. Significant historical, biological (threatened and endangered plant and animal species, coastal spray zone sensitive habitat) and archaeological resources are present onsite.

An alternative that cannot meet this criterion will not be considered further.

### 5.1.2 Criterion 2- Compliance with ARARs

This criterion is used to evaluate compliance of each remedial alternative with ARARs, or whether invoking waivers to specific ARARs is adequately justified. The ARARs are identified based on the type of hazardous substances present, waste characteristics, physical site characteristics, and other appropriate factors. ARARs were presented and described in section 3.1.

The ARARs identified for this site are location specific and include the Endangered Species Act, the Archaeological Resources Protection Act, and the Migratory Bird Act. The alternative is evaluated by how its implementation impacts the habitats of the endangered species present, how destructive it will be of the valuable archaeological resources present and how implementation will potentially affect migratory birds. No chemical-specific or action-specific ARARs have been identified for the site.

An alternative that cannot meet this criterion will not be considered further.

### 5.1.3 Criterion 3—Long-Term Effectiveness and Permanence

This criterion addresses the long-term effectiveness of each alternative and assesses the magnitude of residual risk at the site after implementation of the alternative, and the adequacy of the alternative in limiting the hazard. It also evaluates the effectiveness of the controls in place to manage the residual risk, the required LUCs, and LTM.

### 5.1.4 Criterion 4 - Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion assesses each alternative against the CERCLA preference that alternatives permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances as their principal element. The reduction of volume, or removal of UXO, is the primary factor for MEC at former MBR.

Factors of this criterion that are evaluated include the following:

- The volume of MEC to be destroyed, treated, or recycled.
- The type and quantity of residual MEC that would remain on site.
- The management of the MPPEH, and Disposal processes for MEC and MDAS.
- How the management of MEC will reduce the explosive hazard and mobility.
- The degree to which the treatment is irreversible.

For a site with MEC hazards present, reducing the explosive hazard would involve removing the MEC available for interaction with receptors.

### 5.1.5 Criterion 5 - Short-Term Effectiveness

The short-term effectiveness criterion addresses the effects of the alternative during the implementation phase until RAOs are met. Table 5-2 provides the factors and considerations evaluated under Criterion 5.

**Table 5-2: Criterion 5 Factors and Considerations**

| Analysis Factor | Consideration |
|---|---|
| Protection of the community during the remedial action | Risks to the community that must be addressed<br>How the risks will be addressed and mitigated<br>Remaining risks that cannot be readily controlled |
| Protection of workers during the remedial action | Risks to the workers that must be addressed<br>How the risks will be addressed and mitigated<br>Remaining risks that cannot be readily controlled |
| Environmental impacts | Environmental impacts that are expected with the implementation of the alternative<br>Mitigation measures that are available and their reliability to minimize potential impacts.<br>Impacts that cannot be avoided, should the alternative be implemented. |
| Time until RAOs are achieved | The time to achieve protection against the threats being addressed<br>The time until any remaining threats are addressed<br>The time until RAOs are achieved |

### 5.1.6 Criterion 6 - Implementability

This criterion evaluates the technical and administrative feasibility (that is, the ease or difficulty) of implementing each alternative, and the availability of required services and materials during its implementation. Table 5-3 provides the analysis factors and considerations evaluated under Criterion 6 for a site with a MEC hazard present.

**Table 5-3: Criterion 6 Factors and Considerations**

| Analysis Factor | Consideration |
|---|---|
| **Technical Feasibility** | |
| Ability to employ the technology necessary to implement the alternative | Difficulties associated with implementation<br>Uncertainties associated with implementation |
| Reliability of the technology | The likelihood that technical problems will lead to schedule delays |
| Ease of undertaking additional remedial action | Likely future remedial actions that may be anticipated<br>Difficulty implementing additional remedial actions |
| Monitoring considerations | Migration or exposure pathways that cannot be monitored adequately<br>Risks of exposure should the monitoring be insufficient to detect failure. |
| **Administrative Feasibility** | |
| Coordination with other agencies | Steps required to coordinate with regulatory agencies<br>Steps required to establish long-term or future coordination among agencies<br>The ease of obtaining permits for offsite activities, if required |
| **Availability of Services and Materials** | |
| Availability of treatment, storage capacity, and disposal services | Availability of adequate treatment, storage capacity, and disposal services<br>Capacity considerations of treatment. |
| Availability of necessary equipment and specialists | Additional provisions required to verify that equipment and specialists are available |
| Availability of prospective technology | Whether the technology under consideration is generally available and sufficiently demonstrated |

For all options requiring field work, logistical challenges are present due to site remoteness, but all were handled successfully during the RI field work. All agencies affiliated with the site have been cooperative in the RI/FS process to date. All permits required to complete the work were obtainable for RI field activities. There are no Rights of Entry (ROE) problems at the site. However, lodging space is limited and restricts the size of field teams available to do the work, which extends the duration of fieldwork.

A major logistical challenge at the site is obtaining vehicles. The site can only be accessed by water or air. The barge only arrives once a year, and there are no helicopter lifts capable of delivering a full size

vehicle. During 2013 RI fieldwork, vehicles belonging to residents on site were used, but many were in a state of deterioration and may not be viable for long in the future.

The TTU has a limited capacity and could slow operations. A dedicated operator was not required to handle the volumes of UXO found during the RI, but may be necessary if a full surface MEC removal or MEC removal of the high MEC density area is conducted.

### 5.1.7 Criterion 7 - Costs

This criterion evaluates the cost of implementing each alternative. The estimated cost of an alternative encompasses anticipated engineering, construction, and operations and maintenance (O&M) costs incurred over the life of the project. In accordance with CERCLA guidance, cost estimates for the remedial alternatives were developed with an expected accuracy range of –30 to +50 percent. In the development of the costs for each alternative, indirect costs were added to the construction costs as percentages of the total capital cost. Indirect costs consist of bid and scope contingency (contingencies are part of the direct construction cost), project management, engineering and support, and construction management. Percentages were determined based on the uncertainty, total capital cost, and/or complexity of the project. Detailed estimated costs for each alternative are presented in Appendix C.

This criterion assesses the costs of the remedial action alternative based on present worth. To estimate the present value of the alternative cost, a discount rate of 1.9 percent has been used, which is the 30-year Real Treasury Interest Rate published by the Office of Management and Budget in Circular A-94 (http://www.whitehouse.gov/omb/circulars_a094_a94_appx-c/) for 2014. The discount rate, which is similar to an interest rate, is used to account for the time value of money over 30 years. A dollar is worth more today than in the future, because if invested in an alternative use today, the dollar could earn a return (that is, interest).

The cost of a remedial action alternative includes capital costs and O&M costs over the period of time deemed appropriate and practicable for the selected remedial alternative. Capital costs include all costs to conduct the remedial action. O&M costs include labor and associated maintenance costs expended over time. Periodic costs include the costs for the 5-year reviews to evaluate the effectiveness of the alternative.

### 5.1.8 Criterion 8 - State/ Support Agency Acceptance

This assessment evaluates the technical and administrative issues and concerns the state (or support agency in the case of State-lead sites) may have regarding each of the alternatives. This criterion will be addressed in the DD once comments on the RI/FS report and proposed plan have been received and will not be addressed further in the FS.

### 5.1.9 Criterion 9 - Community Acceptance

This criterion evaluates the issues and concerns the public may have regarding each of the alternatives. As with State acceptance, this criterion will be addressed in the DD once comments on the RI/FS report and Proposed Plan have been received and will not be addressed further in the FS.

## 5.2 ANALYSIS OF ALTERNATIVES

This section presents an analysis and evaluation of the remedial alternatives developed for the former MBR Range Complex No. 1 MRS.

The following remedial action alternatives were selected and are analyzed below against the threshold and balancing evaluation criteria:

- Alternative - 1: No Action.
- Alternative - 2: LUCs.

- Alternative - 3: Surface MEC Removal of entire Target Area, LUCs.
- Alternative - 4: Surface MEC Removal (Trail, Road, and High Density Area), LUCs.
- Alternative - 5: Surface MEC Removal (Trail and Road) and Subsurface/Subsurface Removal (High MEC Density area), LUCs.
- Alternative - 6: Subsurface/Subsurface MEC Removal (Trail, Road, and High MEC Density area), LUCs.
- Alternative - 7: Surface/Subsurface MEC Removal to allow unlimited use/unlimited exposure.

Alternative 7 was not considered further primarily due to the presence of sensitive biological resources on site, and the highly destructive nature of the option to site vegetation. The historical status of the site currently limits intrusive activity, and the only anticipated future uses involving intrusive activity involve installation of signage. A full surface/subsurface MEC removal would involve extensive vegetation clearance, which would require the taking of threatened and endangered species as well as many native Hawaiian plant species. This decision to drop Alternative 7 is further supported by the reluctance of the NPS to grant permission on vegetation removal of native Hawaiian plants during the 2013 RI.

### 5.2.1 Alternative – 1, No Action

Under the No Action remedial alternative, no new actions would be taken to reduce the known MEC hazard present on site. The current regulations in place to protect the historical nature of the site would remain in place unchanged. The site would remain unfenced and under the control of the HDOH and NPS, with management transitioning to the NPS after patient operations end. Current LUCs in place are highly restrictive. Restrictions limit the number of visitors in the park, the areas that can be entered, and require a permit for park access. The park visitors who leave the Kalaupapa Settlement, gain access through Park personnel and are required to obtain a permit. Note, the NPS is currently exploring future management alternatives that could potentially allow visitors unlimited access (although not likely). No cost is assumed for this alternative. The No Action alternative is used solely for comparison, as required by the NCP in 40 CFR 300.430(e)(6)40 CFR 300.430(e)(6).

#### 5.2.1.1 Overall Protection of Human Health and the Environment

Alternative - 1 would not meet the criteria for overall protection of human health because no further action would be taken to reduce the known MEC hazard present on the surface and in the subsurface soil. It is possible current and future site workers and visitors could be exposed to unacceptable explosive hazards.

#### 5.2.1.2 Compliance with ARARs

Alternative – 1 is compliant with ARARs. There are no ARARs that would restrict implementation.

#### 5.2.1.3 Long-Term Effectiveness and Permanence

Alternative - 1 would not provide any reduction of source of MEC hazard and would therefore provide no long-term effectiveness or permanence.

#### 5.2.1.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative - 1 includes no actions that would reduce the toxicity, mobility or volume of the MEC hazard present at the site.

The MEC HA score for this option is 795, which corresponds to a hazard rating of 2, and correlates to a high explosive hazard.

5.2.1.5 Short-Term Effectiveness

Alternative - 1 involves no action; therefore, no short-term risks to the community, workers, or the environment would occur as a result of implementing this alternative.

5.2.1.6 Implementability

Alternative - 1 would result in no technical or administrative feasibility issues, and requires no services or equipment because no action would be taken.

5.2.1.7 Costs

Alternative - 1 would have no capital, O&M costs, or periodic costs beyond what is already in place for historical and spiritual preservation.

### 5.2.2 Alternative – 2, Land Use Controls

A detailed description of Alternative - 2 is presented in Section 4.1.2. This alternative includes signage, education regarding the explosive hazard present, and guidance to site users on actions to follow if MEC is encountered, and access restrictions. The alternative includes further restrictions on land use to be put in place to ensure future protection, should the existing LUCs currently in place for historical reasons ever be reduced. The land restrictions are recommended to be added to the NPS GMP currently in development. Five-year reviews would be required to evaluate the effectiveness of the action.

5.2.2.1 Overall Protection of Human Health and the Environment

Alternative - 2 would provide protection to human receptors by providing awareness of the explosive hazard present, information on actions to follow if UXO were encountered, and by restricting access and intrusive activities at the site. The effectiveness would rely on receptors understanding and following guidance if UXO is encountered. The alternative provides no actions that reduce the source of the MEC hazard and therefore, it is possible current and future site workers and users could be exposed to an explosive hazard if warnings are not followed. The protectiveness of this alternative is dependent on site user understanding of and compliance with educational and access controls. The protectiveness provided to human health by this alternative is not is not adequate.

5.2.2.2 Compliance with ARARs

Alternative – 1 is compliant with ARARs. There are no ARARs that would restrict implementation.

5.2.2.3 Long-Term Effectiveness and Permanence

Alternative - 2 provides long-term effectiveness or permanence as long as warnings regarding MEC hazard are understood and followed by visitors and park personnel. Effectiveness of controls would need to be evaluated every 5 years.

5.2.2.4 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative - 2 includes no actions that would reduce the toxicity, mobility or volume of the MEC hazard present at the site.

The MEC HA score for this option is 795, which corresponds to a hazard rating of 2, and correlates to a high explosive hazard.

5.2.2.5 Short-Term Effectiveness

Alternative - 2 involves no onsite action beyond installation of signage; therefore, site workers would only be exposed to a minimal explosive hazard a result of implementing this alternative. UXO qualified personnel would be present for MEC avoidance support during installation of signage. No adverse

impacts to the Kalaupapa Settlement, historical settlement structures, community or environment are anticipated.

Negligible environmental impacts could occur during installation of signage.

5.2.2.6 Implementability

Alternative - 2 would be technically and administratively feasible. LUCs are currently in place at the site for historical and environmental protection purposes. The NPS is currently exploring alternatives to develop a GMP. A MEC awareness component could easily be added to the existing site rules and regulations or to the GMP when completed. If this alternative or alternatives that require LUCs are chosen a LUCIP would be prepared detailing specifics on the controls.

5.2.2.7 Costs

The costs to implement Alternative - 2 are detailed in Appendix C. The estimated costs include capital costs, annual O&M costs, and periodic costs associated with Five Year Reviews. Capital costs include implementation of the remedy and annual O&M costs include sign maintenance, educational materials. The estimated total present worth cost to implement Alternative - 2 over a 30-year period is shown on Table 5-4.

### 5.2.3 Alternative – 3, Surface MEC Removal of Entire Target Area, LUCs (233 acres)

A detailed description of Alternative - 3 is presented in Section 4.1.3. This alternative includes MEC removal of surface and partially buried MEC from within the entire Range Complex No. 1 – Target Area MRS. There would be no removal of subsurface MEC. This would require removal of vegetation obstructing the visual surface investigation. An analog metal detector capable of detecting both ferrous and non-ferrous metals would be used to search accumulated vegetation and could help reduce some of the vegetation removal required. Vegetation is sparse in the eastern portions of the MRS and increases in the southwesterly direction. This alternative would require implementation of LUCs as detailed previously in Alternative - 2. LUCs would focus on providing awareness and restriction of intrusive activities. Five year reviews would be required to evaluate the effectiveness of the action.

5.2.3.1 Overall Protection of Human Health and the Environment

Alternative - 3 would provide a high level of protection to human receptors by reducing the UXO present on the ground surface, thus limiting the opportunity for interaction between the UXO and human receptors. This alternative is only effective if site use is limited to surface activities only, and would require land use controls to restrict all intrusive activities. However, current and future land use is likely to only involve surface use activities. Installation of signage would require intrusive activities, and require support by UXO qualified personnel for avoidance. The protectiveness of this alternative is dependent on site user understanding of and compliance with educational and access controls.

This alternative would require heavy vegetation removal in the western portions of the site and would be highly destructive to the sensitive biological resources. The protectiveness of the environment is not adequate.

5.2.3.2 Compliance with ARARs

Alternative - 3 would need to comply with the ARARs identified for the site considering the Threatened and Endangered Species Act, the Archaeological Resources Protection Act, and the Migratory Bird Act. The large amount of vegetation removal necessary would cause environmental damage; therefore, a Biologist and an Archaeologist would accompany field teams to provide guidance on avoidance. The areas within the sensitive coastal spray zone are sparsely vegetated and vegetation removal is likely not necessary in this area near the coast. However, in the areas of thicker vegetation to the west, threatened and endangered species and native Hawaiian plants may need to be fully removed. Would need to focus

effort to avoid destruction of biological and archaeological resources, but it is possible an ARAR waiver regarding threatened and endangered species may need to be obtained to complete this Alternative. The extensive vegetation removal associated with this project would not be compliant with ARARs.

#### 5.2.3.3 Long-Term Effectiveness and Permanence

Alternative - 3 is effective as a long-term remedial remedy if site users comply with restrictions on intrusive activity. It is possible subsurface UXO items remaining in the accessible areas could be exposed by strong storms after the MEC removal.

#### 5.2.3.4 Reduction of Toxicity, Mobility, and Volume through Treatment

The surface MEC removal of Alternative - 3 provides a total reduction of the volume of UXO present on the surface and partially buried. No volume reduction for subsurface MEC. The MEC HA score for this option is 540, which corresponds to a hazard rating of 3, and correlates to a moderate explosive hazard.

The pathway for interaction between MEC and receptor is eliminated by the surface removal, but it is possible strong storms could expose residual MEC.

#### 5.2.3.5 Short-Term Effectiveness

The surface MEC removal of Alternative - 3 would present a hazard to the field crew handling the UXO during removal and disposal operations. The field crew would also be exposed to other standard hazards present during field work. This would be addressed by employment of qualified UXO personnel, and a solid work plan accompanied by daily review of activities and hazards present. Only UXO Qualified Personnel would handle the UXO or engage in disposal operations.

UXO Qualified Personnel would be needed for MEC avoidance support during installation of signage. No adverse impacts to the Kalaupapa Settlement or historical settlement structures are anticipated.

The threatened or endangered species, native Hawaiian plants, and archaeological features would likely be affected by vegetation removal; therefore a Biologist and an Archaeologist would accompany field teams to minimize hazards. The potential for environmental impact increases on the western side of the site where vegetation is the heaviest.

#### 5.2.3.6 Implementability

Alternative - 3 would be technically and administratively feasible. Qualified UXO Personnel are readily available. Vegetation removal could potentially endanger threatened and endangered species. If the types of UXO items found during the MEC removal are in line with RI findings, a TTU would be employed to thermally treat UXO items and eliminate potential MC impacts to the environment from disposal operations.

The adverse effects to sensitive biological resources could affect the implementation of this alternative.

Lodging availability at the Kalaupapa Settlement limits the size of field teams, and extends duration of fieldwork. Vehicles available for site use are not readily available. No other restrictions on implementability have been identified.

#### 5.2.3.7 Costs

The costs to implement Alternative - 3 are detailed in Appendix C. The estimated costs include capital costs, annual O&M costs, and periodic costs associated with Five Year Reviews. Capital costs include implementation of the remedy and annual O&M costs include sign maintenance, educational materials. The estimated total present worth cost to implement Alternative - 3 over a 30-year period is period is shown on Table 5-4.

### 5.2.4 Alternative – 4, Surface MEC Removal along Trail and Dirt Road within Target Area, and High MEC Density Area; LUCs (37.74 acres total)

A detailed description of Alternative - 4 is presented in Section 4.1.4. This Alternative includes removal of MEC and MD on the surface and partially buried along the dirt road that runs through the center of the target area (plus 25 ft on either side), the trail near the shoreline (plus 25 ft on either side), and the high MEC density area. A total of 37.74 acres would receive surface clearance, which accounts for the overlapping acreage of the road and high MEC density area. This alternative would require implementation of LUCs as detailed previously in Alternative - 2. Five year reviews would be required to evaluate the effectiveness of the action.

#### 5.2.4.1 Overall Protection of Human Health and the Environment

Alternative - 4 would provide protection to human receptors by reducing UXO in the areas likely to be used by site visitors and park personnel. This alternative would also provide protection to park personnel who may need to go into the high MEC density area. This alternative is only effective for site visitors if site access is restricted to designated areas. This would require land use controls that restrict all intrusive activities unless accompanied by UXO support for MEC avoidance. Signage would be required to inform visitors of the access and intrusive activity restriction. The protectiveness of this alternative is dependent on site user understanding of and compliance with educational and access controls.

This alternative provides protection to the environment by reducing the area that is impacted by MEC removal. Vegetation removal will be required for visual inspection of the surface in some areas. The trail near the shoreline is located in the coastal spray zone, however, the vegetation is sparse and vegetation removal likely may not be required. The area on either side of the trail near the target area center will likely require some level of vegetation removal, increasing in the westerly direction. The impacted acreage would be significantly minimized by the focused MEC removal and provide protection of the environment.

#### 5.2.4.2 Compliance with ARARs

Alternative - 4 is compliant with ARARs identified for the site; including the Threatened and Endangered Species Act, the Archaeological Resources Protection Act, and the Migratory Bird Act. Biologist and Archaeologist will accompany field teams to ensure all efforts will be made to minimize or avoid destruction of biological and archaeological resources. No vegetation removal is anticipated in the areas on either side of the road in the coastal spray zone, but the thicker vegetation in the vicinity of the road near the site center and the high MEC density area will likely require moderate vegetation removal. No vegetation removal will likely be necessary in the critical habitat (located near the trail close to the shoreline) for the two endangered plant species known to be present onsite. Long-Term Effectiveness and Permanence

Alternative – 4 is effective as a long-term removal remedy if site users understand and comply with restrictions. It is possible subsurface UXO items remaining in the accessible areas could be exposed by strong storms after the MEC removal. Effectiveness of controls would need to be evaluated every 5 years.

#### 5.2.4.3 Reduction of Toxicity, Mobility, and Volume through Treatment

For Alternative – 4, the volume of UXO present on the surface within the focused removal areas will be reduced, with no reduction in the subsurface. There will be no reduction of volume on the surface or subsurface in the areas that do not receive MEC removal.

The MEC HA score for this option in the MEC removal areas is 540, which corresponds to a hazard rating of 3, and correlates to a moderate explosive hazard. In the areas that receive no surface removal, the score is 795, with a rating of 2 – high explosive hazard.

The pathway for interaction between MEC and receptor is eliminated in the areas most used by site users by the surface removal on the road and trail, but it is possible strong storms could expose residual subsurface MEC.

#### 5.2.4.4 Short-Term Effectiveness

The surface MEC removal of Alternative - 4 would present a hazard to the field crew encountering and possibly handling the UXO during removal and disposal operations. The field crew would also be exposed to the standard hazards present during field work. This would be addressed by employment of Qualified UXO Personnel, and a solid work plan, accompanied by review of daily activities and hazards present. Only UXO qualified personnel would handle the UXO or engage in disposal operations. UXO Qualified Personnel would be needed for MEC avoidance support during installation of signage.

A moderate level of vegetation removal would be required, most removal would be outside the coastal spray zone near the road at target center and in the high MEC density area, and it is possible threatened or endangered species and archaeological features could be affected. A Biologist and an Archaeologist would accompany field teams to minimize hazards.

No adverse impacts to the Kalaupapa Settlement or historical settlement structures are anticipated.

#### 5.2.4.5 Implementability

Alternative - 4 would be technically and administratively feasible. Qualified UXO personnel are readily available. Vegetation removal could potentially disturb sensitive biological and archaeological resources. If the types of UXO items found are in line with RI findings, a TTU would be employed to thermally treat UXO items and eliminate MC impacts to the environment.

The adverse effects to sensitive biological resources from vegetation removal could affect the implementation of this alternative.

Lodging availability at the Kalaupapa Settlement limits the size of field teams. Vehicles available for site use are not readily available. No other restrictions on implementing have been identified.

#### 5.2.4.6 Costs

The costs to implement Alternative - 4 are detailed in Appendix C. The estimated costs include capital costs, annual O&M costs, and periodic costs associated with Five Year Reviews. Capital costs include implementation of the remedy and annual O&M costs include sign maintenance, educational materials. The estimated total present worth cost to implement Alternative - 4 over a 30-year period is shown on Table 5-4.

### 5.2.5 Alternative - 5, Surface MEC Removal along Trail and Dirt Road within Target Area (4.59 acres) *and* Surface/Subsurface MEC Removal in High MEC Density Area (33.15 acres); LUCs

A detailed description of Alternative - 5 is presented in Section 4.1.5. Alternative - 5 includes removal of MEC and MD on the surface and partially buried along the trail near the shoreline (plus 25 ft on either side) (2.6 acres), the dirt road that runs through the center of the target area (plus 25 ft on either side) (3.4 acres); and a surface/subsurface removal of MEC in the high MEC density area (33.15 acres). This alternative would require implementation of LUCs as detailed previously in Alternative - 2. Five year reviews would be required to evaluate the effectiveness of the action. The site user understanding and compliance with educational controls associated with this alternative would affect the protectiveness of this alternative.

#### 5.2.5.1 Overall Protection of Human Health and the Environment

Alternative - 5 would provide a high level of protection to human receptors by reducing UXO present onsite in areas where site users have access. This alternative would require some level of a restriction on intrusive activities throughout the site. In the areas that receive surface removal or no MEC removal, all intrusive activities would be restricted. In the area that receives surface/subsurface removal intrusive activities below 2.0 ft, would be restricted. Signage would be required to inform visitors of the access and intrusive activity restriction. The protectiveness of this alternative is dependent on site user understanding of and compliance with educational and access controls.

Vegetation removal will be required in some areas. The trail near the shoreline is located in the coastal spray zone, however, the vegetation is sparse and vegetation removal may not be required. The area on either side of the road near the site center may need some level of vegetation removal. The vegetation removal in the high MEC density area could be extensive and destructive to endangered species and native Hawaiian plants, but the smaller acreage associated with focused MEC removal would significantly minimize impacted acreage and provide protection to the environment.

#### 5.2.5.2 Compliance with ARARs

Alternative – 5 is compliant with ARARs identified for the site; including the Threatened and Endangered Species Act, the Archaeological Resources Protection Act, and the Migratory Bird Act. A Biologist and an Archaeologist will accompany field teams to ensure all efforts will be made to avoid destruction of biological and archaeological resources. No vegetation removal is anticipated in the areas on either side of the road in the coastal spray zone, but the thicker vegetation in the vicinity of the road and high MEC density area near the site center will likely require moderate to heavy vegetation removal. No vegetation removal will likely be necessary in the critical habitat (located near the trail close to the shoreline) for the two endangered plant species known to be present onsite.

#### 5.2.5.3 Long-Term Effectiveness and Permanence

Alternative - 5 is effective as a long-term removal remedy if site users understand and comply with restrictions. It is possible subsurface UXO items remaining in the accessible areas could be exposed by strong storms after the MEC removal. Effectiveness of controls would need to be evaluated every 5 years.

#### 5.2.5.4 Reduction of Toxicity, Mobility, and Volume through Treatment

For Alternative - 5, the volume of UXO present on the surface within the trail and road removal areas will be reduced, with no reduction in the subsurface. The volume of UXO in the high MEC density area will be reduced in both the surface and subsurface to a depth of 2 ft. Based on RI findings of UXO to 1.5 ft, all UXO in this area could be removed.

The MEC HA score for this option in the surface MEC removal areas (along the road and trail) is 540, which corresponds to a hazard rating of 3, and correlates to a moderate explosive hazard. The score in the areas that receive surface/subsurface removal is 400, with a rating of 4 – low explosive hazard; and in the areas that receive no MEC removal the score is 795, with a rating of 2 – high explosive hazard.

The pathway for interaction between MEC and receptor is eliminated in the areas most used by site users by the surface removal on the road and trail, but it is possible strong storms could expose residual subsurface MEC. The target area would be less affected by erosion from strong storms, due to the deeper location of any residual MEC.

#### 5.2.5.5 Short-Term Effectiveness

The MEC removal of Alternative - 5 would present a hazard to the field crew encountering and possibly handling the UXO during removal and disposal operations. The field crew would also be exposed to the standard hazards present during field work. This would be addressed by employment of Qualified UXO

Personnel, and a solid work plan accompanied by daily review of daily activities and hazards present. Only UXO Qualified Personnel would handle the UXO or engage in disposal operations. UXO Qualified Personnel would be needed for MEC avoidance support during installation of signage.

The threatened or endangered species, native Hawaiian plants, and archaeological features would likely be affected by vegetation removal; therefore a Biologist and an Archaeologist would accompany field teams to minimize hazards. The potential for environmental impact is most likely to occur in the area where subsurface work is conducted.

No adverse impacts to the Kalaupapa Settlement or historical settlement structures are anticipated are anticipated.

5.2.5.6 Implementability

Alternative - 5 would be technically and administratively feasible. Qualified UXO Personnel are readily available. Vegetation removal could potentially disturb sensitive biological and archaeological resources. If the types of UXO items found are in line with RI findings, a TTU would be employed to thermally destroy UXO items and eliminate MC impacts to the environment.

The adverse effects to sensitive biological resources could affect the implementation of this alternative.

Lodging availability at the Kalaupapa Settlement limits the size of field teams, and results in extended duration of fieldwork. Vehicles available for site use are not readily available. No other restrictions on implementing have been identified.

5.2.5.7 Costs

The costs to implement Alternative - 5 are detailed in Appendix C. The estimated costs include capital costs, annual O&M costs, and periodic costs associated with Five-Year Reviews. Capital costs include implementation of the remedy and annual O&M costs include sign maintenance, educational materials. The estimated total present worth cost to implement Alternative - 5 over a 30-year period is shown on Table 5-4.

### 5.2.6 Alternative - 6, Surface / Subsurface MEC Removal along Trail and Dirt Road within Target Area, and in High MEC Density Area; LUCs (37.74 total acres)

A detailed description of Alternative - 6 is presented in Section 4.1.6. Alternative – 6 includes a Surface/Subsurface MEC Removal of MEC along the trail near the shoreline (plus 25 ft on either side) (2.6 acres), the dirt road that runs through the center of the target area (plus 25 ft on either side) (3.4 acres); and in the high MEC density MEC area (33.15 acres). A total of 37.74 acres would receive MEC removal which accounts for the portion of the road that crosses the high MEC density area. This alternative would require implementation of LUCs as detailed previously in Alternative - 2. Five-year reviews would be required to evaluate the effectiveness of the action. The site user understanding and compliance with educational controls associated with this alternative would affect the protectiveness of this alternative.

5.2.6.1 Overall Protection of Human Health and the Environment

Alternative - 6 would provide adequate protection to human receptors by removing the majority of MEC anticipated to be on site, and removing the MEC potentially present in the areas where site visitors have access. This alternative would provide protection to park personnel who may need to go into the high MEC density area. This alternative would require a restriction on all intrusive activities in the areas outside the acreage that receive MEC removal and restriction of intrusive activities below 2.0 ft in the areas that receive surface/subsurface clearance. Signage would be required to inform visitors of the access

and intrusive activity restriction. The protectiveness of this alternative is dependent on site user understanding of and compliance with educational and access controls.

The vegetation removal in the high MEC density area could be extensive and destructive to endangered species and native Hawaiian plants, but the focused MEC removal would significantly minimize acreage that receives MEC removal and provide protection to the environment.

5.2.6.2 Compliance with ARARs

Alternative - 6 is compliant with the ARARs identified for the site; including the Threatened and Endangered Species Act, the Archaeological Resources Protection Act, and the Migratory Bird Act. A Biologist and an Archaeologist will accompany field teams to ensure all efforts will be made to avoid destruction of biological and archaeological resources. The thicker vegetation in the vicinity of the high MEC density area near the site center will likely require moderate to heavy vegetation removal. No vegetation removal will likely be necessary in the critical habitat (located near the trail close to the shoreline) for the two endangered plant species known to be present onsite.

5.2.6.3 Long-Term Effectiveness and Permanence

This alternative is very effective as a long-term removal remedy because there is significant reduction of MEC in areas where people access the site and in the areas where the majority of the MEC is likely to be located. Effectiveness of controls would need to be evaluated every 5 years.

5.2.6.4 Reduction of Toxicity, Mobility, and Volume through Treatment

For Alternative - 6, the volume of UXO along the trail and road and in the high MEC density area will be significantly reduced in both the surface and subsurface. All MEC present below 2.0 ft will remain. However, no MEC was found deeper than 1.5 ft in the RI. The volume of UXO present in the areas that do not receive MEC removal will not be reduced.

The MEC HA score in the areas that receive Surface/Subsurface MEC Removal is 400, with a rating of 4 – low explosive hazard. The score in areas that receive no MEC removal is 795, with a rating of 2 – high explosive hazard. The potential for UXO mobility and surface exposure through erosion processes will be highly reduced if not eliminated in the area that receives Surface/Subsurface MEC Removal.

The pathway for interaction between MEC and receptor is eliminated in the areas that receive surface/subsurface MEC removal, but there is a small possibility strong storms could expose residual MEC.

5.2.6.5 Short-Term Effectiveness

The MEC removal of Alternative - 6 would present a hazard to the field crew encountering and possibly handling the UXO during removal and disposal operations. The field crew would also be exposed to the standard hazards present during field work. This would be addressed by employment of Qualified UXO Personnel, and a solid work plan accompanied by daily review of daily activities and hazards present. Only UXO Qualified Personnel would handle the UXO or engage in disposal operations. UXO Qualified Personnel would be needed for MEC avoidance support during installation of signage.

It is likely threatened or endangered species and archaeological features could be affected. A Biologist and an Archaeologist would accompany field teams to minimize hazards. It is possible that if a UXO item was encountered that needed to be disposed by BIP procedures, endangered plants or animals could be affected. No adverse impacts to the Kalaupapa Settlement or historical settlement structures are anticipated.

#### 5.2.6.6 Implementability

Alternative - 6 would be technically and administratively feasible. Qualified UXO Personnel are readily available. Vegetation removal could potentially disturb sensitive biological and archaeological resources. If the types of UXO items found are in line with RI findings, a TTU would be employed to thermally treat UXO items and eliminate MC impacts to the environment.

The adverse effects to sensitive biological resources could affect the implementation of this alternative.

Lodging availability at the Kalaupapa Settlement limits the size of field teams, and extends duration of fieldwork. Vehicles for site use are not readily available. No other restrictions on implementing have been identified.

#### 5.2.6.7 Costs

The costs to implement Alternative - 6 are detailed in Appendix C. The estimated costs include capital costs, annual O&M costs, and periodic costs associated with Five Year Reviews. Capital costs include implementation of the remedy and annual O&M costs include sign maintenance, educational materials. The estimated total present worth cost to implement Alternative - 6 over a 30-year period is shown on Table 5-4.

### 5.2.7 Alternative - 7, Surface/Subsurface MEC Removal of Entire Target Area MRS to allow Unlimited Access/Unlimited Exposure (233 acres)

Alternative - 7 includes a full surface/subsurface removal throughout the Target Area (233 acres). The subsurface areas would be cleared of MEC to 10 ft or bedrock which ever was encountered first. This alternative provides a MEC removal that achieves NDAI and site closeout could be achieved. No LUCs or 5-year reviews would be required.

#### 5.2.7.1 Overall Protection of Human Health and the Environment

Alternative - 7 would provide the highest level of protection to human receptors as it would remove all MEC technologically feasible to remove from the site. No land use restrictions or signage would be required.

This option would be highly destructive to archaeological resources, threatened and endangered plant species, and native Hawaiian plants present onsite and will not be considered further.

## 5.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, the findings of the detailed analysis of the potential remedial alternatives are used to compare the alternatives with one another. The purpose of the comparative analysis is to identify the relative advantages and disadvantages of each alternative so that key tradeoffs affecting the selection of a remedial alternative can be identified. The following sections describe the results of the comparative analysis in terms of the first seven CERCLA evaluation criteria presented in Section 5.2. As noted earlier, Criteria 8 and 9 data will be evaluated after public comment on the RI/FS Report and Proposed Plan is received.

### 5.3.1 Overall Protection of Human Health and the Environment

This criterion needs to provide adequate protection of both Human Health and the environment. The more protection of human health generally comes with a tradeoff of more destruction to the environment in implementing the alternative.

Of the alternatives under consideration, Alternatives - 4, -5, and -6 would provide adequate protection of both human health and the environment.

Alternatives -1 and -2 do not provide adequate protection of human health.

Alternative -3 does not provide adequate protection of the environment.

### 5.3.2 Compliance with ARARs

Alternatives - 1 and - 2 would be compliant with ARARs.

All alternatives requiring vegetation removal for MEC removal would require a Biologist and an Archaeologist on site and have potential to cause some damage to threatened and endangered species, and could require a waiver. The remaining alternatives ranked in the order of least to most damage to the environment and decreasing order of compliance with ARARs are Alternatives - 4, - 5, - 6, and - 3.

### 5.3.3 Long-term Effectiveness and Permanence

Alternatives - 1 and - 2 do not reduce the source of the MEC hazard present onsite, and therefore there is no long-term effectiveness or permanence.

Alternative - 2 reduces potential interaction between MEC and a receptor if visitors are aware and are compliant with access restrictions and education on MEC avoidance and the restrictions remain in place.

Alternative - 3 removes all surface and partially buried MEC, and effectively removes the MEC hazard as long as there is understanding and compliance with the land use limitation of no intrusive activities, and the items remain subsurface. It is possible wind and storm erosion could expose items.

Alternative - 4 provides the same degree of physical permanence as Alternative - 3, but in a smaller area.

Alternative - 5 provides the same level of permanence as Alternatives - 3 and 4 in areas where visitors access the site, and a high level of permanence in the high MEC density area, which is accessed by park personnel.

Alternative - 6 would provide the most level of permanence, as it removes MEC in the surface and subsurface in the areas where visitors access the site, and in the high MEC density area.

### 5.3.4 Reduction of Toxicity, Mobility, or Volume

A surface removal would remove all surface and partially buried MEC and leave MEC in the subsurface. A subsurface removal would remove MEC on the surface and subsurface to a depth of 1.5 ft, only leaving potential MEC beneath 1.5 ft, which at this site is expected to be minimal, if any. This would reduce chances for interaction between the MEC and receptor, depending on user activity.

Alternatives - 1 and - 2 do nothing to reduce the volume of MEC contamination, but both reduce the chances of interaction between the MEC and receptor based on land use restrictions. Alternative - 2 would provide some reduction of the MEC hazard present based on the MEC awareness provided in educational controls.

Alternative - 3 would remove identified MEC on the surface. It would also remove volume over many acres where visitors have no access.

Alternative - 5 would remove UXO from the surface in the area where visitors have access, leaving residual MEC in the subsurface; and remove UXO surface and subsurface in the area where UXO is the most concentrated.

Alternative - 6 would remove UXO surface and subsurface in the area where visitors have access, and in the area where MEC is most concentrated.

Alternative - 4 would remove UXO from the surface in the area where visitors have access and in the area where MEC is concentrated, leaving residual MEC in the subsurface.

A MEC HA was performed for each GRA and the results of the scores for GRAs combined in alternatives are presented in Table 5-4. Note: The total MEC HA scores and the associated hazard levels are qualitative references only and should not be interpreted as quantitative measures of explosive hazard.

**Table 5-4: MEC HA Scores and Ratings**

| Alternative | Score* | Rating/Level of Explosive Hazard Present |
|---|---|---|
| Alternative - 1: No Action | 795 | 2 – High |
| Alternative - 2: LUCs | 795 | 2 – High |
| Alternative - 3: Full Surface MEC Removal of Target Area, LUCs | 540 | 3 – Moderate |
| Alternative - 4: Surface MEC Removal (road, trail, and High MEC Density Area), LUCs | 795-540 | Varies<br>2 – High (no MEC removal)<br>3 – Moderate (Surface MEC removal Areas) |
| Alternative – 5: Surface MEC Removal (road and trail) and Surface/Subsurface MEC Removal (High MEC Density Area), LUCs | 795-400 | Varies<br>2 – High (no MEC removal)<br>3 – Moderate (Surface RA)<br>4 – Low (Surface/Subsurface MEC removal) |
| Alternative – 6: Surface/Subsurface MEC Removal (road , trail, and High MEC Density Area), LUCs | 795-400 | Varies<br>2 – High (no MEC removal)<br>4 – Low (Surface/ Subsurface MEC removal) |

**Score and Rating vary according to MEC removal conducted in each area.*

### 5.3.5 Short-Term Effectiveness

None of the alternatives would present a hazard to the Kalaupapa community during implementation of the alternatives.

Alternative - 1 would involve no action and therefore provide no hazards to workers during implementation. For, Alternative - 2 a slight risk to workers could be present during installation of signage. UXO support would be present for MEC avoidance.

Alternatives 3, 4, 5 and 6 each present hazards to workers during sign installation, vegetation clearance, UXO removal and disposal operations, in addition to the standard hazards presented during field work. The order of hazard from least hazardous to most is 4, 3, 5, and 6. Although Alternative - 3 covers more acreage, no intrusive work would be involved and less volume of UXO would likely be encountered than Alternatives - 5 and 6. Approved work plans would be in place for all field work, with daily reviews of procedures for planned work.

### 5.3.6 Implementability

All alternatives are readily implementable. This work is done routinely in the industry. ROE will not be a problem at the site. UXO technicians are readily available. The remoteness of the site presents logistical challenges regarding supplies (helicopter airlift, limited barge schedule) and lodging availability on site at the Kalaupapa Settlement, but all were handled successfully during the RI work. The lodging limitation may put constraints on numbers of field personnel during MEC removal.

Alternatives - 1 and 2 are the easiest to implement, as they require no field work. Implementation of Alternative - 2 would encounter no hindrances as the site is under control of institutions familiar with working together and have a common goal of protecting the historical, spiritual, and ecological settings of the site.

Alternative - 4 is the easiest to implement of the field efforts as it addresses the least acreage and does not involve intrusive work.

The remaining three alternatives face challenges in implementation and would require lengthy field schedules due to the limit on the number of site workers.

### 5.3.7 Costs

The costs to implement each alternative are shown in Table 5-5 with additional details provided in Appendix C.

No cost is associated with Alternative - 1.

The next lowest cost is Alternative - 2, which includes LUCs and no removal fieldwork. It is anticipated the LUCs can be added to the site GMP at some point.

The cost of Alternative - 4 which provides surface MEC removal on a focused area (trail, road, and high MEC density area) is the least expensive of the MEC removal alternatives.

Alternative - 5, which provides surface removal in roads and trails and surface/subsurface removal in the high MEC density area is slightly less than Alternative – 6, which performs surface/subsurface removal in all three areas.

The cost for Alternative - 3 is the most expensive of all options under consideration due to the large acreage receiving MEC removal and extensive vegetation removal that would be needed from the site center towards the west.

**Table 5-5: Summary of Alternatives Cost Analysis**

| Alternative Action | Cost | | |
|---|---|---|---|
| | **Capital** | **Periodic + O&M 30 Year Total Cost** | **Present Worth Total Cost*** |
| Alternative –1<br>No Action | $0 | $0 | $0 |
| Alternative - 2<br>LUCs | $120,000 | $1,147,000 | $986,000 |
| Alternative - 3<br>Surface MEC Removal of Entire Target Area | $11,757,000 | $1,177,000 | $12,645,000 |
| Alternative - 4<br>Surface MEC Removal (trail and dirt road, and high MEC density area) | $3,199,000 | $1,177,000 | $4,087,000 |
| Alternative - 5<br>Surface MEC Removal (trail and dirt road) and Surface / Subsurface MEC Removal (high MEC density area) | $30,645,000 | $1,177,000 | $31,532,000 |
| Alternative - 6<br>Surface / Subsurface MEC Removal (trail, dirt road, and high MEC density area) | $30,696,000 | $1,177,000 | $31,680,000 |

*Expected accuracy range of -30 to +50 percent. Periodic and O&M costs are estimated over 30 years. Total cost represents the rounded present worth value considering a discount rate of 1.9 % for 30 years. Costs are rounded to nearest $1,000 per EPA guidance.*

**Table 5-6: Summary of Detailed Analysis of Remedial Alternatives**

| Alternative | Overall Protection of Human Health and the Environment | Compliance with ARARS | Long-Term Effectiveness and Permanence | Reduction in Toxicity, Mobility, Volume | Short-Term Effectiveness | Implementability | Cost (Present Worth) |
|---|---|---|---|---|---|---|---|
| Alternative - 1<br>No Action | -Provides some protection to human health based on LUCs in place for historical protection purposes, but not adequate protection.<br>-Provides adequate protection of environment. | Compliant with ARARs | -No reduction in MEC source.-No Long-Term Effectiveness and Permanence. | -No reduction in volume of UXO.<br>- Current LUCs in place reduce chance of human interaction with MEC. | No hazards presented to workers, Kalaupapa Settlement or environment. | No action associated with this alternative. | $0 |
| Alternative - 2<br>LUCs | -Protective of human health by ensuring the current land use restrictions remain and add a MEC educational component, but not adequate protection.<br>-Adequate protection of environment. | Compliant with ARARs | -No reduction in MEC source.-Long-Term Effectiveness and Permanence depends on the site users understanding and following restrictions. | -No reduction in volume of UXO.<br>-LUCs would ensure current LUCs stay in place, and reduce the hazard by providing site users an awareness of the hazard present and instruction on what to do if UXO is encountered. | No hazards presented to Kalaupapa Settlement, negligible hazard to site workers and environment. | Most Implementable of all alternatives that involve action. | $986,000 |
| Alternative - 3<br>Surface MEC Removal of entire Target Area MRS; LUCs | -Protective of human health.<br>-Not protective of the environment. Highly destructive to the environment, particularly in western portion of site. | Not Compliant with ARARs | -Long-Term Effectiveness and Permanence depends on site users understanding and following restrictions and UXO remaining subsurface.<br>-Provides most reduction of MEC on surface | -Removes UXO from the ground surface in the most acreage of all alternatives. Residual subsurface UXO remain.<br>-Breaks the exposure pathway for humans to interact with UXO as long as it stays subsurface | No hazards presented to Kalaupapa Settlement, some hazard to site workers, most impact to environment of alternatives involving MEC removal. | -Limited lodging will limit number of field team members and extend fieldwork. Logistics difficult for obtaining site vehicles.<br>-Most impact to environment that may affect acceptability of implementation. | $12,645,000 |
| Alternative - 4<br>Surface MEC Removal (trail and dirt road, and high MEC density area); LUCs | -Protective of human health.<br>-Adequate protection of the environment because acreage impacted by removal is significantly minimized. | Compliant with ARARs | -Long-Term Effectiveness and Permanence depends on site users understanding and following restrictions and UXO remaining subsurface.<br>-Provides reduction in areas likely accessed by site users. | -Removes UXO from the ground surface in areas site users are most likely to access and in the area where MEC is concentrated. Residual UXO may remain in subsurface.<br>-Breaks the exposure pathway for humans to interact with UXO as long as residual UXO stays subsurface in access areas, and the access areas do not change. | No hazards presented to Kalaupapa Settlement, minor hazard to site workers, least impact to environment of alternatives involving MEC removal. | -Limited lodging will limit number of field team members and extend duration of fieldwork.<br>-Logistics difficult for obtaining site vehicles.<br>-Least impact to environment that may affect acceptability of implementation. | $4,087,000 |
| Alternative - 5<br>Surface MEC Removal (trail and dirt road)<br>and<br>Surface / Subsurface MEC Removal (high MEC density area); LUCs | -Protective of human health.<br>-Adequate protection of the environment because acreage impacted by removal is significantly minimized. | Compliant with ARARs | -Long-Term Effectiveness and Permanence depends on site users understanding and following restrictions and UXO remaining subsurface.<br>-Provides reduction of MEC in areas likely accessed by site users. | -Removes the volume of UXO from the ground surface in areas site users are most likely to access and also in the subsurface of the high MEC density area. Little residual UXO is anticipated to remain.<br>-Breaks the exposure pathway for humans to interact with UXO as long as residual UXO stays subsurface and the access areas do not change. | No hazards presented to Kalaupapa Settlement, some hazard to site workers, some impact to environment. | -Limited lodging will limit number of field team members and extend duration of fieldwork.<br>-Logistics difficult for obtaining site vehicles.<br>-Some impact to environment that may affect acceptability of implementation. | $31,532,000 |
| Alternative - 6<br>Surface / Subsurface MEC Removal (trail, dirt road, and high MEC density area); LUCs | -Protective of human health.<br>-Adequate protection of the environment because acreage impacted by removal is significantly minimized. | Compliant with ARARs | -Long-Term Effectiveness and Permanence depends on site users understanding and following restrictions and UXO remaining subsurface.<br>-Most MEC removed from site. | -Removes the most volume of from subsurface. Least residual UXO remains subsurface of all alternatives.<br>-Breaks the exposure pathway for humans to interact with UXO in the areas where users have access. | No hazards presented to Kalaupapa Settlement, some hazard to site workers, some impact to environment. | -Limited lodging will limit number of field team members and extend duration of fieldwork.<br>-Logistics difficult for obtaining site vehicles.<br>-Some impact to environment that may affect acceptability of implementation. | $31,680,000 |

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**Table 5-7: Summary of Detailed Analysis of Remedial Alternatives**

| Alternative | Overall Protection of Human Health and the Environment [Note 1] | Compliance with ARARS [Note 2] | Long-Term Effectiveness and Permanence | Reduction in Toxicity, Mobility, Volume [Note 3] | Short-Term Effectiveness | Implementability | Cost | Overall Rank |
|---|---|---|---|---|---|---|---|---|
| Alternative - 1<br>No Action | 6 | 1 | 6 | 6<br>MEC HA Score/Rating<br>795 / 2 (High Explosive Hazard) | 1 | 1 | 1 | 22 |
| Alternative - 2<br>LUC | 6 | 1 | 5 | 5<br>MEC HA Score/Rating<br>795 / 2 (High Explosive Hazard) | 2 | 2 | 2 | 23 |
| Alternative - 3<br>Surface MEC Removal of entire Target Area MRS, and LUCs | 6 | 6 | 3 | 3<br>MEC HA Score/Rating<br>540 / 3 (Moderate Explosive Hazard) | 4 | 6 | 4 | 32 |
| Alternative - 4<br>Focused Surface MEC Removal (trail and dirt road, and high MEC density area), and LUCs | 1 | 1 | 4 | 4<br>MEC HA Rating would vary per area as follows:<br>In areas receiving Surface MEC Removal:<br>MEC HA Score/Rating<br>540 / 3 (Moderate Explosive Hazard)<br>---<br>Areas with no MEC removal:<br>MEC HA Score/Rating<br>795 / 2 (High Explosive Hazard) | 3 | 3 | 3 | 19 |
| Alternative - 5<br>Surface MEC Removal (trail and dirt road) and<br>Surface / Subsurface MEC Removal in high MEC density area, and LUCs | 1 | 1 | 2 | 2<br>MEC HA Rating would vary per area as follows:<br>In area receiving Surface/Subsurface MEC Removal<br>MEC HA Score/Rating<br>400 / 4 (Low Explosive Hazard)<br>---<br>Areas receiving Surface MEC Removal:<br>MEC HA Score/Rating<br>540 / 3 (Moderate Explosive Hazard)<br>---<br>Areas with no MEC removal:<br>MEC HA Score/Rating<br>795 / 2 (High Explosive Hazard) | 5 | 4 | 5 | 20 |
| Alternative - 6<br>Surface / Subsurface MEC Removal (trail, dirt road, and high MEC density area), and LUCs | 1 | 1 | 1 | 1<br>MEC HA Rating would vary per area as follows:<br>Areas receiving Surface/Subsurface MEC Removal<br>MEC HA Score/Rating<br>400 / 4 (Low Explosive Hazard)<br>---<br>Areas with no MEC removal:<br>MEC HA Score/Rating<br>795 / 2 (High Explosive Hazard) | 6 | 5 | 6 | 21 |

*Scoring is ranked on a relative score of 1 to 6 scale with 1 = most favorable/desirable, and 6 = least favorable/desirable*
*Note 1: Protectiveness is ranked as a 1=Adequate protection of both Human Health and Environment or 6=Not adequately protective of both Human Health and Environment. The ranking is not on a relative scale.*
*Note 2: Compliance with ARARS is ranked as a 1=Complies with ARARS or 6=Does not comply with ARARs. The ranking is not on a relative scale.*
*Note 3: MEC HA scores provided associated with the ratings are rated according to the following potential for explosive conditions: 2-High, 3-Moderate, 4-Low. For more detail on the MEC HA evaluation, see Appendix B.*

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# Chapter 6. REFERENCES


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