DRAFT FINAL

MILITARY MUNITIONS RESPONSE PROGRAM (MMRP)

FEASIBILITY STUDY

CULEBRA ISLAND SITE

MRS 02 – Cerro Balcon and Accessible Cayos
MRS 04 – Flamenco Lagoon Maneuver Area
MRS 05 – Combat and Mortar Range Area
MRS 07 – Culebrita Artillery Impact Area

Contract #: W912DY-04-D-0009
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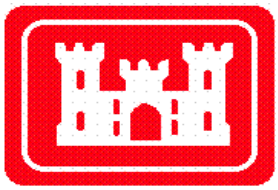

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July 2012

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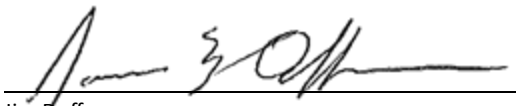
CULEBRA ISLAND, PUERTO RICO



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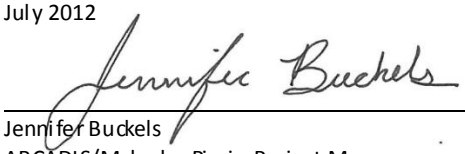

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ACRONYMS

°F	Degrees Fahrenheit
%	percent
µg/kg	Micrograms per kilogram
APP	Accident Prevention Plan
ARARs	Applicable or Relevant and Appropriate Requirements
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
DGM	Digital Geophysical Mapping
DID	Data Item Description
DoD	Department of Defense
EM	Engineer Manual
EP	Engineer Pamphlet
FS	Feasibility Study
FUDS	Formerly Used Defense Site
HA	Hazard Assessment
HHRA	Human Health Risk Assessment
INPR	Inventory Project Report
LTM	Long Term Management
LUC	Land Use Control
MC	Munitions Constituents
MD	Munitions Debris
MDAS	Material Documented as Safe
MEC	Munitions and Explosives of Concern
MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosives Hazard
MRS	Munitions Response Site
MRSPP	Munitions Response Site Prioritization Protocol
NA	Not Applicable
NCP	National Contingency Plan
QC	Quality Control
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study

RSL	Regional Screening Level
SI	Site Inspection
TPP	Technical Project Plan
U.S.	United States
USC	United States Code
USAESCH	United States Army Engineering Support Center, Huntsville
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service

EXECUTIVE SUMMARY

On behalf of the United States (U.S.) Army and, U.S. Army Corps of Engineers (USACE) Jacksonville and Huntsville Districts, Explosive Ordnance Technologies, Inc. (EOTI) and ARCADIS/Malcolm Pirnie (EOTI/ARCADIS) have prepared this Feasibility Study (FS) to evaluate remediation alternatives at Cerro Balcon and Accessible Cayos (Munitions Response Site [MRS] 02), Flamenco Lagoon Maneuver Area (MRS 04), Combat and Mortar Range Area (MRS 05), and Culebrita Artillery Impact Area (MRS 07) at the Culebra Island Formerly Used Defense Site (FUDS) under the Military Munitions Response Program (MMRP). An Inventory Project Report (INPR) was signed on 24 December 1991, establishing the Culebra Island site as a FUDS, defining a site boundary, and assigning FUDS Project No. I02PR006800. A Site Inspection (SI) was conducted and the 2007 Final SI Report recommended all four MRSs proceed to Remedial Investigation (RI)/FS for further evaluation of munitions and explosives of concern (MEC) and munitions constituents (MC).

The RI field activities were completed on 25 March 2011. The RI Report was submitted on 23 November 2011. The fieldwork included geophysical investigations, during which surface and subsurface metallic anomalies were investigated along predefined transects throughout MRS 04, MRS 05, and MRS 07. The transects covered approximately 24 miles (123,000 ft) across the MRSs. In addition, four 25 x 25 foot mini-grids were investigated in areas where indicators of MEC were discovered along the transects. The investigation confirmed that MD was located on the surface and in the subsurface at MRS 04, MRS 05, and MRS 07. During the investigation, MEC associated with a 2.75 inch rocket and a demolition charge was found within MRS 07. No MEC was found in MRS 04 or MRS 05. No investigation was conducted within MRS 02 because the property was inaccessible due to the lack of rights-of-entry (ROEs) within Cerro Balcon, and due to inaccessibility of the cays as a result of unsafe landing areas.

A total of 28 soil samples and 7 sediment samples were collected from MRS 04, MRS 05, and MRS 07 and analyzed for munitions constituents (MC), including explosives and select metals (antimony, barium, chromium, copper, lead, mercury, and zinc). No MC investigations were conducted within MRS 02 due to the lack of rights-of-entry (ROEs) within Cerro Balcon, and due to inaccessibility of the cays as a result of unsafe landing areas. Explosives were not detected in any of the field samples; however, 1-3-5-TNB and 4-NT were found at very low levels in one split sample at MRS 05 collected for quality assurance purposes. Both analytes were well below the US Environmental Protection Agency's (USEPA) Residential Screening Levels (RSL) and were not evaluated as part of the human health or ecological risk assessments. No soil or sediment remediation on the basis of ecological risk is warranted based on the conclusions of the RI. Therefore, MC remedial alternatives are not evaluated within this FS Report.

The RI supported the characterization of MRSs 02, 04, 05 and 07 for the purpose of developing and evaluating effective remedial alternatives. The characterization was

designed to find the nature and extent risks related to MEC and MC within each MRS. The MEC remediation objective for all of the MRSs is to limit interaction between residual MEC and persons accessing the MRSs. Based on the results of the RI fieldwork and review of existing data from previous investigations, the following MRS subareas were evaluated in the FS. Figure 1 illustrates the MRS locations and Figure 2 illustrates the MRS subareas evaluated in the FS following the RI.

MRS 02: MRS 02 includes Cerro Balcon and the cays. Cerro Balcon is landlocked within MRS 05 with different access and receptors than the remainder of the cays because it includes residential properties. The cays also have varied accessibility. While access to all cays is restricted and not permitted, Cayo Lobo and Cayo Yerba are known to be frequented by recreational users, while the other cays are less accessible or frequented. Additionally, a surface removal was previously completed at Cayo Lobo and Cerro Balcon; therefore, the potential for receptors to encounter MEC on the ground surface is reduced. Based on this information, MRS 02 has been split into four subareas for further evaluation in the FS:

- MRS 02 - Cerro Balcon
- MRS 02 - Cayo Lobo
- MRS 02 - Cayo Yerba
- MRS 02 - Inaccessible Cays (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Aqua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)

MRS 04: MRS 04 is located in the northern portion of Culebra. The U.S. Fish and Wildlife Service (USFWS) own property along the northern and eastern MRS boundary (Figure 2) where receptors and land use vary when compared to the remainder of MRS 04. The U.S. Fish and Wildlife Area contain no residential or commercial properties, while the remainder of MRS 04 includes a combination of residential, commercial, and recreational land uses. Therefore, to examine alternatives, the U.S. Fish and Wildlife Area was evaluated separate from the remainder of the MRS in the following subareas.

- MRS 04 U.S. Fish and Wildlife Area
- MRS 04 (remaining lands)

MRS 05: MRS 05 encompasses a majority of Culebra. The USFWS owns a portion of the MRS. Receptors and land use varies in the U.S. Fish and Wildlife Area when compared to the remainder of MRS 05 because the U.S. Fish and Wildlife Area does not have residential properties. The remainder of MRS 05 includes a combination of residential, commercial, and recreational land uses. Therefore, to examine alternatives, the U.S. Fish and Wildlife Area was evaluated separate from the remainder of the MRS in the following subareas.

- MRS 05 U.S. Fish and Wildlife Area
- MRS 05 (remaining lands)

MRS 07: Based on the results of the RI, no subareas were developed within MRS 07.

The FS develops remedial alternatives, as listed below, to offer a range of remedial approaches as required by CERCLA guidance. MRSs and subareas have been grouped below into categories based on similar proposed alternatives. Proposed alternatives are based on land use, receptors, and previous removals.

Table ES- 1: Remedial Alternatives for MRS 02 – Inaccessible Cays

Alternative	Description
1	No Action.
2	Land Use Controls (LUCs) to include signs and public education.
3	LUCs and a surface removal of MEC/MPPEH along beaches only.
4	LUCs and a surface removal of MEC/MPPEH from the entire Subarea.

Table ES- 2: Remedial Alternatives for MRS 02 –Cayo Lobo and MRS 07

Alternative	Description
1	No Action.
2	LUCs to include signs and public education.
3	LUCs and a subsurface removal of MEC/MPPEH within frequented areas only (i.e., beaches and/or trails).

Table ES- 3: Remedial Alternatives for MRS 02 –Cayo Yerba, MRS 04 U.S. Fish and Wildlife Area, and MRS 05 U.S. Fish and Wildlife Area

Alternative	Description
1	No Action.
2	LUCs to include signs and public education.
3	LUCs and a surface removal of MEC/MPPEH within frequented areas only (i.e., beaches and trails).
4	LUCs and a surface/subsurface removal of MEC/MPPEH within frequented areas only (i.e., beaches and trails).

Table ES- 4: Remedial Alternatives for MRS 02 –Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)

Alternative	Description
1	No Action.
2	LUCs to include signs, and public education.
3	LUCs and a surface removal of MEC/MPPEH from accessible portions of the Subarea. (Note - inaccessible areas are characterized by steep/hazardous slopes, thick vegetation, and/or non-compliance with ARARs).
4	LUCs and a subsurface removal of MEC/MPPEH from accessible portions of the Subarea. (Note - inaccessible areas are characterized by steep/hazardous slopes, thick vegetation, and/or non-compliance with ARARs)

The remedial alternatives were evaluated using the nine NCP criteria:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)
- Short-term effectiveness
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Implementability
- Cost
- Regulatory acceptance
- Community acceptance.

The comparative performance of each of the alternatives for all the revised MRSs is presented in Section 4.3.

1 INTRODUCTION

1.1 PURPOSE

This Feasibility Study (FS) Report has been prepared on behalf of the United States Army Corps of Engineers (USACE) to further remedial activities under the Military Munitions Response Program (MMRP) in Culebra, Puerto Rico. This FS Report has been prepared in accordance with the U.S. Environmental Protection Agency (USEPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (1988) and the *Munitions Response Remedial Investigation/Feasibility Study Guidance* [United States Army Corps of Engineers (USACE) & United States Army Environmental Command (USAEC), 2009d].

An Inventory Project Report (INPR) was signed on 24 December 1991, establishing Culebra as a Formerly Used Defense Site (FUDS), defining a site boundary, and assigning FUDS Project Number I02PR006800. Culebra was subsequently investigated during a Site Inspection (SI) in 2007. The Final SI Report recommended a RI for munitions and explosives of concern (MEC) and munitions constituents (MC) to be conducted at Munitions Response Site (MRS) 02, MRS 04, MRS 05, and MRS 07.

The objective of the project is to characterize the nature and extent of contamination within MRSs 02, 04, 05, and 07 and obtain acceptance of a Decision Document meeting the requirements of ER 200-3-1 and the Center of Expertise (CX) Interim Guidance 06-04. The RI field activities were completed on 25 March 2011. The RI Report was submitted on 23 November 2011. The purpose of the FS is to evaluate remedial alternatives for Culebra MRSs and provide decision makers with the data necessary to select an alternative.

1.2 DESCRIPTION AND HISTORY

Culebra is approximately seventeen miles east of San Juan, Puerto Rico and nine miles north of Vieques (Figure 1). The Vieques Sound separates Culebra from Puerto Rico. The Caribbean Sea lies to the south, and the Atlantic Ocean is to the north. The total land area of Culebra and its outlying cays is approximately 7,300 acres, of which approximately 1,500 acres are owned by the United States Fish and Wildlife Service (USFWS). Puerto Rico Department of Natural and Environmental Resources (DNER) owns 1,200 acres and private citizens and the Municipality of Culebra own the remaining 4,600 acres.

The Island of Culebra, nearby cays, and surrounding water were used between 1902 and 1975 for training and live fire of bombs, mortars, rockets, torpedoes, projectiles, and small arms. Beginning in 1978, all of the land acquired by the military on Culebra and the surrounding cays were excessed to the Department of the Interior or transferred to

the government of Puerto Rico by quitclaim deed. These lands are currently managed by USFWS, DNER, or the Municipality of Culebra. No official lease or transfer documents have been identified for the remainder of the privately owned land; however, any portion of the island may have been used by the military during its long history of training on Culebra.

The Culebra FUDS consists of 13 MRSs, totaling 9,460 acres (8,430 land acres and 1,030 acres of water). This FS covers 4 of the 13 MRSs: MRS 02, MRS 04, MRS 05, and MRS 07, as illustrated in Figure 1. Below is a description of each MRS.

1.2.1 MRS 02 – Cerro Balcon and Accessible Cayos

MRS 02 includes Cerro Balcon, Cayo Ballena, Cayo Lobo (also known as Cross Cay), Cayo Lobito, Cayo Del Agua (also known as Water Key), Cayo Yerba, Cayo Raton, Los Gemelos (also known as Twin Rock), Cayo Geniqui (also known as Palada Cay), and Cayo Sombrerito (Figure 1). Cerro Balcon is a former 30-acre mortar range in the center of MRS 05. The cays consist of approximately 84.8 acres and were used for training and live fire of high-explosive (HE) bombs, projectiles, and rockets, as well as illumination and practice rounds until 1975. All cays are considered conservation priority areas for Culebra. Currently, the USFWS manages the cays associated with MRS 02.

1.2.2 MRS 04 – Flamenco Lagoon Maneuver Area

The 550-acre MRS 04 includes Flamenco Lagoon and the hillside east of the lagoon (Figure 1). Records show that Combat Range #2, located on the south side of Flamenco Beach, was used for direct and indirect fire of small arms and 81mm mortars from firing positions on the hillside within MRS 04 during FLEX #4 in 1938. Firing positions for 75mm projectiles used in 1939 were also located in MRS 04. The majority of the MRS is currently under private ownership. DNER manages the property along the beaches on the northeastern side of the site.

1.2.3 MRS 05 –Combat and Mortar Range Area

MRS 05, the largest MRS, includes most of the landmass between Resaca Beach and Carenero Point, totaling approximately 2,812 acres (Figure 1). Cerro Balcon Mortar Range, which is part of MRS 02, is surrounded by MRS 05. Historical training records indicate that many of the hills in this area may have been used for direct fire. Uunexploded ordnance (UXO) has been identified on portions of the MRS 05 property. MRS 05 includes areas used for combat, target, and sweep-of-fire range training. Most of MRS 05 is privately owned; however, USFWS manages a large portion of the property surrounding Mount Resaca and DNER manages the property along the beaches on the northeastern side of the site.

1.2.4 MRS 07 – Culebrita Artillery Impact Area

The 351 acre MRS 07 includes the northern portion of Culebrita as well as Cayo Botella (also known as Ladrone Cay) (Figure 1). The water portion of the MRS (24 acres) is addressed under a separate contract. Culebrita was used as an artillery impact area and for an aircraft bombing/rocket target in 1969. Culebrita beaches and trails are used recreationally, and many boats visit the island each year. This MRS is managed by the USFWS.

1.2.5 MRS Subareas

As a result of the RI fieldwork and review of existing data from previous investigations, MRS 02, 04 , and 05 have been divided into subareas for the purposes of developing and evaluating remedial alternatives as part of the FS. The subareas are presented in Section 1.6 and are addressed as such throughout the remainder of the FS.

1.3 ENVIRONMENTAL SETTING

Culebra has sandy beaches, irregular rugged coastlines, lagoons, coastal wetlands, steep hills and narrow valleys. Ninety percent of the island is hilly, with the residential population concentrated in the flatlands. Mount Resaca is the highest point on the island, approximately 630 feet above mean sea level. The island has a limited variety of soil types due to its volcanic origin, limited size, rugged terrain, and moderately uniform climate. Most soils, except along the slopes and on the beaches, are the result of weathering bedrock. The soils are well-drained, runoff is rapid, and permeability is moderate. Vegetation is moderately to extremely dense on undeveloped portions of Culebra and Culebrita. However, vegetation is sparse or absent on many of the smaller cays, as most are rocky with very little soil.

Surface water is scarce, and creeks and streams are intermittent and seasonal. Fresh water is scarce. There are some shallow (10 to 20 feet deep) wells in areas away from coastal seepage, but the groundwater is high in chloride concentrations and salinity. Potable water is supplied by a desalination plant built by the Navy and a water line from Puerto Rico.

Currently Culebra has schools, residential areas, a medical clinic, an airport, restaurants, hotels, shops and a few industrial companies. There are two main commercial areas: the town of Dewey, located on the west side of the Great Harbor, and the area surrounding the airport. Most residential development is on the northwest end of Great Harbor; however, residences are scattered throughout the island. Lower Town, Flamenco Point, Mount Resaca, Northwest Peninsula, and all of the beaches are managed by the USFWS or DNER for wildlife conservation and recreational use. It is anticipated that land use on the island will remain the same, and development for similar purposes will likely continue.

1.4 NATURE AND EXTENT OF CONTAMINATION

RI fieldwork was conducted from 11 October 2010 to 25 March 2011, in accordance with the approved Final MMRP Work Plan (EOTI, 2010) and decisions made during technical project planning (TPP) sessions. The fieldwork included geophysical investigations, during which surface and subsurface metallic anomalies were investigated along predefined transects throughout MRS 04, MRS 05, and MRS 07. The transects covered approximately 24 miles (123,000 ft) across the MRSs. In addition, four 25 x 25 foot mini-grids were investigated in areas where indicators of MEC were discovered along the transects. One grid was located in MRS 04 and three were located in MRS 05. No investigations were conducted in MRS 02 due to the lack of rights-of-entry (ROE) in the Cerro Balcon area and the inability of field teams to access the cays, which comprise the remainder of MRS 02. The cays are difficult to access due to steep terrain and inadequate landing areas. The field teams attempted access to the cays but were deterred by rough seas. While access to all of the cays is prohibited, Cayo Lobo and Cayo Yerba are more accessible than the other cays by recreational users (trespassers). Portions of MRS 04 and 05 were not investigated by the field teams due to lack of ROEs, and in some cases, due to access issues caused by heavy vegetation and terrain.

In total, 466 anomalies were intrusively investigated across MRS 04, MRS 05, and MRS 07. During the investigation, 49 pieces of munitions debris (MD) (items without an explosive hazard) were found, totaling 43 pounds. MD included items associated with mortars, 3-inch projectiles, 20mm projectiles, flares, fuzes, small arms ammunition, and unidentifiable fragments. The investigation confirmed that MD was located on the surface and in the subsurface at MRS 04, MRS 05, and MRS 07. During the investigation, MEC associated with a 2.75 inch rocket and a demolition charge was found within MRS 07. No MEC was found in MRS 04 or MRS 05. The remainder of the 466 anomalies were identified as either non-munitions-related metallic debris, such as barb wire and small arms ammunition not related to military use, or geologic anomalies. Table ES-1 summarizes the MEC investigation results for each MRS.

A total of 28 soil samples and 7 sediment samples were collected from MRS 04, MRS 05, and MRS 07 and analyzed for munitions constituents (MC), including explosives and select metals (antimony, barium, chromium, copper, lead, mercury, and zinc). No samples were collected from MRS 02 due to lack of a ROE and inaccessibility issues for the Cays. Explosives were not detected in any of the field samples; however, 1-3-5-TNB and 4-NT were found at very low levels in one split sample at MRS 05 collected for quality assurance purposes. Both analytes were well below the US Environmental Protection Agency's (USEPA) Residential Screening Levels (RSL) and were not evaluated as part of the human health or ecological risk assessments. While detected metals concentrations in the RI surface soil samples from MRS 04, MRS 05, and MRS 07 were, for the most part, greater than the range of concentrations in background soil samples, they were less than the USEPA RSLs for Resident Soil. No background sediment data

were available; however, detected metals concentrations in sediment samples from MRS 04, MRS 05, and MRS 07 were also less than the USEPA RSLs for Resident Soil. Based on the Baseline Risk Assessment conducted as part of the RI, MC will not be further addressed in the FS.

1.5 SUMMARY OF MEC HAZARD ASSESSMENT

The Munitions Response Site Prioritization Protocol (MRSPP) and Conceptual Site Model (CSM) for the MRSs, as presented in the 2007 Final SI Report, were updated in the RI Report based on the RI fieldwork results (Section 6.2.1 of the RI Report). The revised CSM reflects incomplete exposure pathways for all human and ecological receptors of MEC at the surface for MRS 02 – Cerro Balcon and Cayo Lobo, where surface clearances have been conducted. Complete pathways exist for receptors of MEC in the subsurface at MRS 02 - Cerro Balcon and Cayo Lobo, because MEC is confirmed on site, and no subsurface clearance was conducted. Complete pathways also exist for both the surface and subsurface at MRS 07 due to the presence of MEC found during previous investigations and during the RI. Potentially complete pathways exist on the surface and subsurface for all other cays and MRS 04 and 05. While data is available to suggest low MEC density, data gaps remain for these sites based on lack of ROEs and inaccessibility issues.

Table 1- 1: MRS MEC Pathway Analysis

MRS	Description
02	• Incomplete pathways for MEC on the surface at Cerro Balcon and Cayo Lobo • Complete pathways for MEC in the subsurface at Cerro Balcon and Cayo Lobo • Complete pathways for MEC at both the surface and subsurface at all other cays
04	Potentially complete pathways for MEC at both the surface and subsurface
05	Potentially complete pathways for MEC at both the surface and subsurface
07	Complete pathways for MEC at both the surface and subsurface

The MRSPP for each MRS was updated to include the types of munitions encountered during the RI, as well as the results of MC sampling conducted. A baseline MEC Hazard Assessment (MEC HA) was also completed for the each MRS using the MEC HA guidance and accompanying automated scoring worksheets. The MEC HA evaluated RI data and categorized all sites as high risk except for the cays, which were categorized as moderate risk.

As discussed in Section 6.3.3 of the RI Report, MEC risk was qualitatively evaluated using a combination of the CSM, the MRSPP, and the MEC HA assessment. During the FS, MEC

risk was re-evaluated further after separating out the sub-areas for remedial alternatives evaluation. The MEC risk for Cerro Balcon is considered high. While no RI data was collected in this area due to lack of ROEs, MEC was found during a 2006 surface clearance. However, this clearance did not extend into the subsurface. Cerro Balcon is heavily populated and receptors include residents, commercial workers, and recreational users. Based on the receptor types, subsurface MEC does pose a risk at this time. Although a surface clearance was conducted, overtime subsurface MEC can resurface due to migration pathways.

For the inaccessible cays, the overall MEC risk is considered low based on the low probability of receptors to access these locations. The Cays are difficult to access based on steep terrain and lack of landing points, as well as rough seas. No residents or structures are located on any of the cays.

For Cayo Lobo and Yerba, the cays which are slightly more accessible, the MEC risk is considered moderate. Cayo Lobo and Cayo Yerba are known to be frequented by recreational users. These cays are slightly larger than the others on which small beaches facilitate access during low tide and good weather conditions. There are no residents on these cays. While a clearance has been conducted on Cayo Lobo, this was limited to the surface only with no subsurface investigation.

The MEC risk for MRS 04 and MRS 05 U.S. Fish and Wildlife Areas and Remaining Lands is considered low. This is based on the past investigations and RI data that show little evidence of MEC remaining on these MRSs. No MEC has ever been found within MRS 05. No MEC was found in MRS 04 during the RI, but one MEC item was found on Flamenco Beach during a prior clearance. Overall, the data suggests that very limited MEC and/or MD are present; as such there is a low risk for receptor encounter with MEC.

The MEC risk for MRS 07 is considered moderate. A clearance has been previously completed for the accessible beaches. There is risk of MEC washing up on the shore and resurfacing on beaches. MRS 07 is regularly used as a recreational area. There are trails through the MRS but no residents. MEC was found during the RI.

1.6 MRS SUBAREAS

Based on the results of the RI fieldwork and review of existing data from previous investigations, MRS 02, MRS 04, and MRS 05 have been divided into subareas for the analysis of alternatives. MRS 07 was not divided into subareas.

MRS 02: MRS 02 (114.8 acres) includes Cerro Balcon (30 acres) and the cays (84.8 acres). Cerro Balcon is landlocked within MRS 05 with different access and receptors than the remainder of the cays because it includes residential properties. The cays also have varied accessibility. While access to all cays is restricted and not permitted, Cayo Lobo

(39 acres) and Cayo Yerba (6.5 acres) are known to be frequented by recreational users, while the other cays (39.3 acres) are less accessible or frequented. Additionally, a surface removal was previously completed at Cayo Lobo and Cerro Balcon; therefore, the potential for receptors to encounter MEC on the ground surface is reduced. Based on this information, MRS 02 has been split into four subareas for further evaluation in the FS:

- MRS 02 - Cerro Balcon
- MRS 02 - Cayo Lobo
- MRS 02 - Cayo Yerba
- MRS 02 - Inaccessible Cays (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Aqua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)

MRS 04: MRS 04 (550 acres) is located in the northern portion of Culebra. The U.S. Fish and Wildlife Service (USFWS) own property (57.4 acres) along the northern and eastern MRS boundary (Figure 2) where receptors and land use vary when compared to the remainder of MRS 04 (492.6 acres). The U.S. Fish and Wildlife Area contains no residential or commercial properties, while the remainder of MRS 04 includes a combination of residential, commercial, and recreational land uses. Therefore, to examine alternatives, the U.S. Fish and Wildlife Area was evaluated separate from the remainder of the MRS in the following subareas.

- MRS 04 U.S. Fish and Wildlife Area
- MRS 04 (remaining lands)

MRS 05: MRS 05 (2,812 acres) encompasses a majority of Culebra. The USFWS own a portion of the MRS (573.5 acres). Receptors and land use varies in the U.S. Fish and Wildlife Area when compared to the remainder of MRS 05 because the U.S. Fish and Wildlife Area does not have residential properties. The remainder of MRS 05 (2,238.5 acres) includes a combination of residential, commercial, and recreational land uses. Therefore, to examine alternatives, the U.S. Fish and Wildlife Area was evaluated separate from the remainder of the MRS in the following subareas.

- MRS 05 U.S. Fish and Wildlife Area
- MRS 05 (remaining lands)

MRS 07: Based on the results of the RI, no subareas were developed within MRS 07 (351 acres).

2 IDENTIFICATION AND SCREENING OF TECHNOLOGIES FOR MEC

2.1 REMEDIAL ACTION OBJECTIVES

The RI supported the characterization of MRSs 02, 04, 05 and 07 for the purpose of developing and evaluating effective remedial alternatives. The characterization was designed to find the nature and extent of MEC and MC within each MRS. The MEC remedial action objective for all of the MRSs is to limit interaction between residual MEC and persons accessing the MRSs. Methods by which interaction between potential receptors and MEC can be limited include, but are not limited to, land use controls (e.g., signage, restrictive use, fencing, etc.), education, and surface and subsurface MEC removals.

2.1.1 Applicable or Relevant and Appropriate Requirements

Response actions under FUDS must identify and attain or formally waive applicable or relevant and appropriate requirements (ARARs) under Federal and State laws (ER 200-3-1). ARARs are used as a "starting point" to determining the protectiveness of a site remedy. When ARARs do not exist for a particular chemical or remedial activity, other criteria, advisories, and guidance referred to as To Be Considered (TBC) are useful in designing and selecting a remedial alternative.

The list of ARARs and TBCs will be updated, particularly as guidance is issued by commonwealth and federal agencies. ARARs and TBCs will be used as a guide to establish the appropriate extent of site cleanup; to aid in scoping, formulating, and selecting proposed treatment technologies; and to govern the implementation and operation of the selected remedial alternative. As part of the FS, primary consideration should be given to remedial alternatives that attain or exceed the requirements of the identified ARARs and TBCs. ARARs and TBCs are identified and used by taking into account the following:

- Contaminants suspected or identified to be at the site;
- Chemical analysis performed, or scheduled to be performed;
- Types of media (air, soil, ground water, surface water, and sediment);
- Geology and other site characteristics;
- Use of site resources and media;
- Potential contaminant transport mechanisms;
- Purpose and application of potential ARARs and TBCs; and
- Remedial alternatives considered for site cleanup.

Chemical-Specific. Chemical-specific requirements define acceptable exposure levels for specific hazardous substances and, therefore, may be used as a basis for establishing preliminary remediation goals and cleanup levels for chemicals of concern in the designated media. Chemical-specific ARARs and TBCs are also used to determine

treatment and disposal requirements for remedial actions. In the event a chemical has more than one requirement, the more stringent of the two requirements will be used.

Location-Specific. Location-specific requirements set restrictions on the types of remedial actions that can be performed based on site-specific characteristics or location. Alternative remedial actions may be restricted or precluded based on federal and state laws for hazardous waste facilities or proximity to wetlands, floodplains or man-made features, such as existing landfills, disposal areas, and local historic landmarks or buildings.

Action-Specific. Action-specific requirements set controls or restrictions on the design, implementation, and performance of remedial actions. They are triggered by the particular types of treatment or remedial actions that are selected to accomplish the cleanup. After remedial alternatives are developed, action-specific ARARs and TBCs that specify remedial action performance levels, as well as specific contaminant levels for discharge of media or residual chemical levels for media left in place, are used as a basis for assessing the feasibility and effectiveness of the remedial action.

ARARs and TBCs at Culebra

Chemical- Specific TBCs	None Applicable
Location-Specific ARARs and TBCs	Endangered Species Act (16 U.S.C 1538 and 1540)
Action-Specific ARARs and TBCs	Migratory Bird Treaty Act (16 U.S.C 703) RCRA Subpart X (40 CFR 264, Subpart X)

2.2 GENERAL RESPONSE ACTIONS

A limited number of MEC response actions are available to address MEC contaminated sites. The following four actions have been identified and will be used in combination with one another to develop remedial alternatives which will be evaluated for potential implementation at each of the sites at Culebra covered under this FS. The MEC-only remedial actions below are typically evaluated for MMRP sites and are considered for Culebra. Alternatives may also be a combination of individual remedial actions.

1. No Action
2. Land Use Controls (LUCs)
3. Surface Removal
4. Subsurface Removal

2.2.1 No Action

The no action response involves taking no action at an MRS. No additional MEC would be removed from the site and no institutional controls would be implemented. The no action response serves as the baseline against which the effectiveness of other alternatives is judged.

2.2.2 Land Use Controls

LUCs are used to reduce and prevent explosive hazard exposure to potential human and ecological receptors. LUCs for MEC generally include physical and/or administrative/legal mechanisms that minimize the potential for exposure by limiting land use. This process does not prevent exposure to MEC in all cases; however, it can effectively prevent exposure by restricting access to these items. LUCS are often used in conjunction with other response actions.

2.2.3 Surface Removal

A surface removal is the removal of any MEC/MPPEH visible in part or whole on the surface. No subsurface removal of MEC/MPPEH would be completed under this action. The surface removal would be conducted by qualified UXO technicians using handheld analog metal detectors. If MEC or MPPEH is discovered, it would be disposed of using explosive demolition procedures. The general components for a surface removal include:

- Vegetation removal (to expose the ground surface only as necessary; no clear cutting)
- Physical surface removal of MEC/MPPEH in designated areas or across the entire site
- Demolition and disposal operations

2.2.4 Subsurface Removal

Subsurface anomalies may be identified using handheld analog magnetometer or digital geophysical mapping (DGM) instruments (e.g. EM-61). Subsurface removal consists of employing geophysical instruments (analog or DGM) to identify subsurface anomalies followed by an intrusive investigation (hand dig and inspect). Surface anomalies are also identified, investigated, and removed as necessary during a subsurface removal. The components of a subsurface removal include:

- Vegetation removal (to expose the ground surface)
- Surface removal of MEC/MPPEH in designated areas or across the entire site
- Subsurface investigations
- Demolition and disposal operations

Investigation and removal techniques include hand digging, mechanical digging with conventional earth moving equipment in conjunction with hand digging; mechanical

digging using armored equipment; and mechanical digging using remotely operated equipment.

2.3 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

As presented in RI/FS guidance section of Engineer Pamphlet (EP) 1110-1-18 (USACE, 2006), the natural characteristics of a particular site may limit the technologies that may be used. Due to the limited number of appropriate technology types and alternatives for MEC only remedial actions, a limited number of remedial alternatives and technologies can be developed to meet the project objectives, as outlined above. A limited screening of technologies, specific for MEC identification and removal as related to Culebra, is included below.

2.3.1 Identification and Screening of Technologies

Potential technologies and technology options corresponding to the identified general response actions for Culebra was compiled, and then reduced by evaluating the technology process options with respect to technical effectiveness, implementability, and cost. Existing information on technologies and site characterization data were used to screen out technologies and process options that cannot be effectively implemented. During this screening step, process options and entire technology types may be eliminated from further consideration. This is accomplished by using available information from the RI site characterization on MEC types, concentrations, distribution, and site characteristics to screen out technologies and process options that cannot be effectively implemented at the site.

MEC technologies were divided into three categories for discussion to include detection, recovery, and disposal technologies. A detailed analysis of all technologies associated with these categories is provided in the MEC Detection, Recovery, and Disposal Technology Assessment Report, USACE, 2005. The following technologies were identified as being viable options for the general response actions. Although these technologies are industry proven for detection and removal of MEC, there are technology limitations and surface/subsurface residual hazards may remain even following a remedial action. Therefore, LUCs are most often necessary for any site where MEC has been previously identified even if a removal action has occurred.

2.3.1.1 Detection Technologies

The objective of MEC detection is to determine the presence and location of potential MEC items during investigation and removal. For Culebra, ground based magnetic and electromagnetic sensors were evaluated. Magnetic sensors often have a greater detection depth but can also be less effective in certain geological condition common in Culebra. The two types of geophysical sensors can be applied to either analog or digital systems. Both digital and analog geophysical equipment can be used to detect MEC in

Culebra. DGM has a higher level of quality control and provides the ability for advanced processing to limit the number of intrusive investigations. The digital data collected provides a record that can be used to document and evaluate the coverage and quality of the clearance. Analog instruments rely on an operator's ability to detect geophysical anomalies potentially caused by MEC based on the real-time response of the instrument. Quality control plans must include a method of ensuring proper coverage and detection. Analog procedures are often more effective in areas with steep, rocky terrain and in areas with limits on clearing vegetation. In areas with sensitive habitats, analog methods may be preferable because vegetation clearing can be more selective. Analog instruments may increase production rates in the type of environment common in Culebra because removal is conducted simultaneously with detection, and because of rapid vegetation re-growth, which may make reacquisition difficult. The depths for a subsurface removal action would be based on site use and depth of munitions. For this effort, it is assumed a combination of analog and digital electromagnetic equipment will be used to locate subsurface anomalies. The selection of specific instruments will need to consider the presence of "hot rock" (i.e. rock with a magnetic signature). Digital EMI systems, such as EM-61, and analog sensors that have ground balancing have been shown to work well in hot rock environments.

2.3.1.2 Recovery Technologies

Removal or recovery technologies generally include hand excavation or mechanized equipment. Hand excavation consists of digging individual anomalies using commonly available hand tools. This is the industry standard method for performing MEC removals and investigations. The individual UXO Technicians dig an anomaly that was either located using hand held instruments or DGM instrument. The method involves using the hand tools (shovels, picks, trowels, etc.) to excavate the selected item using only human power to do the work. Depending on a number of criteria (e.g., expected MEC and operating environment), actual techniques can vary from removal in shallow layers of the covering surfaces to use of pick and shovel for deeper items.

Mechanical equipment can also be used to excavate anomalies, such as with a backhoe or excavator. Advantages can include increase production rates; however, for Culebra, the dense vegetation, steep terrain, and island MRSs with limited accessibility would make use of mechanized equipment challenging. Use of mechanical equipment at Culebra is not anticipated due to the lack of sub-surface on most of the island; there is very little surface soil in most areas before bedrock is encountered.

2.3.1.3 Disposal Technologies

The objective of a removal action is to eliminate or reduce receptor exposure to MEC hazards. Blow-in-Place (BIP) is the destruction of any MEC by detonating the item without moving it from the location where it was found. Normally, this is accomplished

by placing an explosive charge alongside the item. MEC is dealt with individually in this approach, requiring direct exposure of personnel to each individual item.

Consolidate and Blow operations are defined as the collection, configuration, and subsequent destruction by explosive detonation of MEC. This process can be used either "in grid" (i.e., within a current working sector) or at a consolidation point, but can only be employed for munitions that have been inspected and deemed acceptable to move. This determination should be made by senior UXO-qualified personnel in accordance with appropriate regulations and guidance.

2.3.2 Evaluation of Technologies

The evaluation of screened remedial technologies and process options is illustrated in Table 2-1.

General Response Actions	Remedial Technology	Process Option	Effectiveness	Implementability	Cost
No Action	None	Not Applicable	Does not achieve remedial action objectives of reducing receptor exposure to MEC.	Not acceptable to stakeholders.	None
Surface Removal	Detection	Analog	**Medium/High** - Some technologies only detect ferrous anomalies. Appropriate sensors would be necessary for hot rock environments.	**High** - Analog sensors can be easily used in any terrain and easier in thick vegetation.	**Medium** - Manpower intensive. Dependent on vegetation and terrain. Additional seeding for QC required.
	Removal	Manual	**High** - Industry standard for MEC recovery.	**High** - Can be accomplished in almost any terrain and climate. Limited only by the number of people available.	**Low/Medium** - Standard by which all others are measured. Typically this is low cost option.
		Mechanized	**High** - Increases production rate but may not be as effective on steep terrain or with limited access areas	**Medium** - May be limited by steep terrain and inaccessiable areas for equipment (islands).	**Medium/High** - Costs for equipment may be balanced by increased production in accessible areas. Cost may be high to bring in equipment to remote areas.
	Disposal	Blow-in-Place	**High** - Each MEC item is individually destroyed with subsequent results individually verified.	**High** - Techniques, transportable tools, and equipment, suited to most environments. Public exposure can limit viability. Engineering controls improve implementation.	**Medium** - Manpower intensive. Costs increase in areas of higher population densities or where public access must be monitored/controlled. Also may increase costs for explosives (multiple shots).
		Consolidate and Blow	**High** - Techniques recently developed and refined are providing documented successes. Donor munitions also proving effective. Limited in use to munitions that are "safe to move".	**Medium/High** - Generally employs same techniques, tools and equipment as BIP. Requires larger area and greater controls. Most engineering controls not completely effective/applicable for these operations.	**Low/Medium** - Manpower intensive, may require material handling equipment for large scale operations.
Subsurface Removal	Detection	Analog	**Medium/High** - Some technologies only detect ferrous anomalies. Appropriate sensors would be necessary for hot rock environments.	**High** - Analog sensors can be easily used in any terrain and easier in thick vegetation.	**Medium** - Manpower intensive. Dependent on vegetation and terrain. Additional seeding for QC required.
		Digital Geophysical Mapping	**High** - Data is digital and provides a record of detections. Reduces number of digs.	**Medium** - Equipment can be cumbersome and may not be suitaqble to all terrain and climates.	**High** - Additional manpower required. Lower production rates.
	Removal	Hand Excavation	**High** - Industry standard for MEC recovery.	**High** - Can be accomplished in almost any terrain and climate. Limited only by the number of people available.	**Low/Medium** - Standard by which all others are measured. Typically this is low cost option.
		Mechanized	**High** - Increases production rate but may not be as effective on steep terrain or with limited access areas	**Medium** - May be limited by steep terrain and inaccessiable areas for equipment (islands).	**Medium/High** - Costs for equipment may be balanced by increased production in accessible areas. Cost may be high to bring in equipment to remote areas.
	Disposal	Blow-in-Place	**High** - Each MEC item is individually destroyed with subsequent results individually verified.	**High** - Techniques, transportable tools, and equipment, suited to most environments. Public exposure can limit viability. Engineering controls improve implementation.	**Medium** - Manpower intensive. Costs increase in areas of higher population densities or where public access must be monitored/controlled. Also may increase costs for explosives (multiple shots).
		Consolidate and Blow	**High** - Techniques recently developed and refined are providing documented successes. Donor munitions also proving effective. Limited in use to munitions that are "safe to move".	**Medium/High** - Generally employs same techniques, tools and equipment as BIP. Requires larger area and greater controls. Most engineering controls not completely effective/applicable for these operations.	**Low/Medium** - Manpower intensive, may require material handling equipment for large scale operations.

3 DEVELOPMENT AND SCREENING OF ALTERNATIVES

3.1 DEVELOPMENT OF ALTERNATIVES

This section presents the remedial alternatives developed for the following sites at Culebra Island based upon data collected during the RI/FS field activities. Based on varying property use and potential receptors on separate portions of the Culebra Island site and to properly develop and screen alternatives, the MRSs have been divided into the following subareas for evaluation.

- MRS 02 – Cerro Balcon
- MRS 02 – Cayo Lobo
- MRS 02 – Cayo Yerba
- MRS 02 – Inaccessible Cays (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Aqua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)
- MRS 04 U.S. Fish and Wildlife Area
- MRS 05 U.S Fish and Wildlife Area
- MRS 04 (remaining lands)
- MRS 05 (remaining lands)
- MRS 07

Data generated were used to assess the potential safety hazards and/or risks to enable selection of a cost effective and efficient response action (if required). During the RI Report, a MEC HA was conducted for the MEC and MPPEH issues.

Based on the results of the RI and MEC HA, safety hazards associated with MEC and MPPEH exist at all of the MRSs investigated during this RI/FS. The acute nature of the hazard warrants consideration of a munitions response action.

MEC remedial alternatives were developed for potential implementation at each of the subareas based on the results of the RI field work and current/future anticipated land use of the site. Due to the similarity between sites, receptor use, and the limited MEC-only response actions, some of the subareas and MRSs are grouped together and the same set of remedial alternatives are being evaluated for each group (Tables 3-1 to 3-4). A description of each response action included in the developed remedial alternatives is included in Section 2.3. The alternatives represent a reasonable range of alternatives that meet the requirements of EP-1110-1-18 (USACE, 2006a).

Based on current and future anticipated land use, the following MEC-only remedial alternatives have been developed for the MRSs investigated under this FS.

Table 3-1 identifies alternatives for MRS 02 – Inaccessible Cays where receptors are limited to trespassers and USFWS personnel and where intrusive activities are unlikely

based on land use (no residential or construction activities) and the inaccessibility of the cays. Only LUCs and surface removal alternatives are presented and analyzed for MRS 02 – Inaccessible Cays.

Table 3- 1: Remedial Alternatives for MRS 02 – Inaccessible Cays

Alternative	Description
1	No Action.
2	Land Use Controls (LUCs) to include signs and public education.
3	LUCs and a surface removal of MEC/MPPEH along beaches only.
4	LUCs and a surface removal of MEC/MPPEH for the entire Subarea.

Table 3-2 identifies alternatives for MRS 02 - Cayo Lobo and MRS 07, at which the current and future land use is either recreational or undeveloped and intrusive activities are anticipated to be limited based on the receptor use. Receptors include recreational users and USFWS personnel who access specific areas of each MRS due to dense vegetation. Limited surface removals have been completed at both Cayo Lobo and MRS 07. In addition, a limited subsurface removal took place on MRS07 along the Culebrita beaches. Based on removal activities completed, a surface only removal alternative was not evaluated. However, as evident based on the RI results for MRS 07, MEC may still be present in the subsurface. Due to the dynamic nature of the environment MEC has the potential to surface over time, particularly on beaches or areas prone to erosion. For these areas, LUCs, as well as subsurface alternatives are presented and analyzed. LUCs may be used to manage residual risk in a dynamic environment. Dense vegetation at Cayo Lobo and MRS 07 serves as a barrier limiting the areas frequented by recreational users; therefore, only the publically accessible areas are included in surface/subsurface removal alternatives. Figures 3 and 5 show the location of frequented areas for MRS 07 and Cayo Lobo.

Table 3- 2: Remedial Alternatives for MRS 02 – Cayo Lobo and MRS 07

Alternative	Description
1	No Action.
2	LUCs to include signs and public education.
3	LUCs and a surface/subsurface removal of MEC/MPPEH within frequented areas only (i.e., beaches and trails).

Alternatives for MRS 02 – Cayo Yerba, MRS 04 U.S. Fish and Wildlife Area, and MRS 05 U.S. Fish and Wildlife Area are presented in Table 3-3. Receptors include recreational users and USFWS personnel. Intrusive activities are anticipated to be limited based on receptor use (no residential or construction activities). No previous removals have been

conducted in these areas. LUCs, surface only removals, and subsurface removals alternatives are presented. Figures 4 and 5 show the location of frequented areas for USFWS Area and Cayo Yerba.

Table 3- 3: Remedial Alternatives for MRS 02 – Cayo Yerba, MRS 04 U.S. Fish and Wildlife Area, and MRS 05 U.S. Fish and Wildlife Area

Alternative	Description
1	No Action.
2	LUCs to include signs and public education.
3	LUCs and a surface removal of MEC/MPPEH within frequented areas only (i.e., beaches and trails).
4	LUCs and a surface/subsurface removal of MEC/MPPEH within frequented areas only (i.e., beaches and trails).

Table 3-4 identifies alternatives for MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands). All these areas contain a variety of land uses to include residential use. The potential for intrusive activities is greater than in other subareas and MRSs due to residential use and greater potential for development. Receptor access to portions of Cerro Balcon, MRS 04 - remaining lands, and MRS 05 - remaining lands is limited by dense vegetation and steep terrain (greater than 30 degrees). Removal action alternatives (alternatives 3 and 4) were considered for accessible portions only. Approximately 83% of Cerro Balcon, 21% of MRS 04 – remaining lands, and 48% of MRS 05 – remaining lands, is considered accessible. A limited surface clearance was completed at Cerro Balcon; however, due to the current and anticipated land use and the potential for MEC to surface over time LUCs, surface removals, and subsurface removals are presented.

Table 3- 4: Remedial Alternatives for MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)

Alternative	Description
1	No Action.
2	LUCs to include signs and public education.
3	LUCs and a surface removal of MEC/MPPEH from accessible portions of the subarea. (Note - inaccessible areas are characterized by steep/hazardous slopes, thick vegetation, and/or non-compliance with ARARs).
4	LUCs and a surface/subsurface removal of MEC/MPPEH from accessible portions of the subarea. (Note - inaccessible areas are characterized by steep/hazardous slopes, thick vegetation, and/or non-compliance with ARARs).

3.2 SCREENING OF INDIVIDUAL ALTERNATIVES

The preliminary screening of individual alternatives is not required for many MEC sites because of the limited number of response actions and resulting remedial alternatives. Each of the remedial alternatives developed for the sites will be individually and comparatively analyzed in the following sections to determine strengths and weaknesses.

4 DETAILED ANALYSIS OF ALTERNATIVES

The NCP (40 CFR 300) states that the primary objective of the FS is to "ensure that appropriate remedial alternatives are developed and evaluated," and that "the number and type of alternatives to be analyzed shall be determined at each site, taking into account the scope, characteristics, and complexity of the site problem that is being addressed." In this section, the remedial action alternatives that were developed are evaluated against the nine criteria identified in the NCP and how well they meet the RAOs. Remedial alternatives have been developed in an effort to distinguish a cost-effective remedial action that is protective of human health and the environment and can be implemented with conventional means. The first seven criteria are addressed in this report. The last two criteria (regulatory and community acceptance) will be addressed during remedy selection. The nine NCP criteria are provided below:

- Protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through short-term treatment
- Short-term effectiveness
- Implementability
- Cost
- Regulatory acceptance
- Community acceptance

The NCP evaluation criteria can be separated into three categories: threshold criteria, balancing criteria, and modifying criteria. The threshold criteria judges if the alternative is protective of human health and the environment, and in compliance with the ARARs. The balancing criteria look at both the short- and long-term effectiveness and permanence of the alternative, the reduction of volume, implementability, and cost of the alternative. The modifying criteria include the regulatory and community acceptance, which are evaluated in this report based on interactions to date with the regulatory community and public and will be re-evaluated during remedy selection. The final risk management decision is one that determines which cost-effective remedy offers the best balance of all the NCP factors. These criteria take into account both current and future land uses and are applied with regards to the current, as well as, reasonable future land use at the site.

In addition, the information from the MEC HA input factors and outputs can be used to support the analysis of alternatives. The FS examines three broad criteria: Effectiveness, Implementability, and Cost. For the Effectiveness Criterion, the MEC HA input factors of Energetic Material Type, Location of Additional Human Receptors, Site Accessibility, Amount of MEC, and MEC Classification can provide information to support evaluation of short-term effectiveness, and compliance with ARARs.

An estimated cost for each alternative was developed and is presented in detail in Appendix A.

4.1 EVALUATION CRITERIA

Section 300.430(e) of the NCP lists nine criteria against which each remedial alternative must be assessed. The first two criteria are threshold criteria that must be met by each Alternative. The next five criteria are the primary balancing criteria upon which the analysis is based. The final two criteria are referred to as modifying criteria and are applied after the subsequent public comment period to evaluate state and community acceptance. The acceptability or performance of each Alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified.

The two threshold criteria are:

- Protection of human health and the environment; and
- Compliance with ARARs.

The five primary balancing criteria upon which the analysis is based on are:

- Long-term effectiveness and permanence;
- Reduction of volume, or removal, of MEC;
- Short-term effectiveness;
- Implementability; and
- Cost.

The two modifying criteria upon which the analysis is based on are:

- Regulatory acceptance; and
- Community acceptance.

Regulatory and community acceptance evaluation included in the FS are based on previous discussions with regulatory agencies and the community during TPP meetings and field activities. These criteria will be re-evaluated during the CERCLA process following receipt of regulatory comments and public review of the Proposed Plan. The final evaluation for both criteria will be addressed in the Decision Document or Record of Decision.

4.1.1 Overall Protection of Human Health and the Environment

This criterion addresses whether a remedial alternative will achieve adequate protection of human health and the environment and describes how MEC at the site will be eliminated, reduced, or controlled through treatment, engineering, and/or LUCs.

Because there is not an established threshold for MEC hazard, the goal is to effectively minimize or eliminate the exposure pathway between the MEC and receptor.

4.1.2 Compliance with ARARs

Addresses whether a remedial alternative meets all applicable, appropriate, or relevant selected federal and state environmental statutes and regulations. To be acceptable, an alternative shall comply with ARARs or be covered by a waiver.

4.1.3 Long-Term Effectiveness and Permanence

This criterion addresses the ability of a remedial alternative to maintain reliable protection of human health and the environment over time. Considers the magnitude of residual hazard, the adequacy of the response in limiting the hazard, and whether LUCs and long-term maintenance are required.

4.1.4 Reduction of Volume, or Removal, of MEC

This criterion relates to the extent to which the remedial alternatives permanently reduce the volume of MEC and reduces the associated safety hazard. Factors for this criterion for MEC include the degree of permanence of the remedial action, the amount of MEC removed/demolished, and the type and quantity of MEC remaining.

4.1.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during implementation. MEC removal poses risks to workers and the public that are not associated with environmental contaminants that must be considered and controlled.

4.1.6 Implementability

The technical and administrative feasibility of implementing each Alternative and the availability of services and materials are addressed by this criterion. This criterion also considers the degree of coordination required by the regulatory agencies, successful implementation of the remedial action at similar sites, and research to realistically predict field implementability.

4.1.7 Cost

This criterion addresses the capital costs, in addition to annual costs anticipated for implementation of the response action. Costs for the U.S. Fish and Wildlife Area, MRS 04, MRS 05 , and MRS 07 were developed using vegetation clearance and dig rates from the RI field effort.

4.1.8 Regulatory Acceptance

This criterion is used to evaluate the technical and administrative concerns of the regulatory community regarding the alternatives, including an assessment of the regulatory community's position and key concerns regarding the alternative, and comments on ARARs or the proposed use of waivers.

4.1.9 Community Acceptance

This criterion includes an evaluation of the concerns of the public regarding the alternatives. It determines which component of the alternatives interested persons in the community support, have reservations about, or oppose.

4.2 INDIVIDUAL ANALYSIS OF ALTERNATIVES

4.2.1 MRS 02 – Inaccessible Cays (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Aqua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)

4.2.1.1 Alternative 1 - No Action

The No Action Alternative involves taking no action at the inaccessible cays. Under this alternative, no further effort or resources would be expended at the site. An assessment based on the NCP criteria is provided below. The summary of Alternative 1 compared to the NCP criteria is presented in Table 4-1.

4.2.1.1.1 Assessment

Threshold Criteria. Alternative 1 does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC. This alternative does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, Alternative 1 does not meet the remedial action objectives.

Balancing Criteria. Alternative 1 is not effective in the short- or long-term because no precautions would be taken to reduce potential contact with MEC/MPPEH. This alternative does not employ an action that will result in a permanent solution for the site. The reduction of toxicity, mobility, and volume generally refers to MC. However, the "volume" of MEC/MPPEH would not be reduced with Alternative 1 since no action would be taken, nor would "toxicity" as related to exposure be reduced. This alternative is easily implementable as no actions would be taken. Alternative 1 is also the lowest cost alternative since there would be no cost associated with it.

Modifying Criteria. Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC.

4.2.1.2 Alternative 2 – Land Use Controls

Alternative 2 requires that signs be installed on and around the cays and that an educational program be implemented to warn of the potential explosive hazards associated with the site. Dig restrictions would also be placed on public property. A LTM plan would be required to inspect LUCs and provide educational material on a periodic basis. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Table 4-1.

4.2.1.2.1 Assessment

Threshold Criteria. Alternative 2 meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across the adjacent cays is considered moderate based on the historic field activities and previous MEC finds. The cays which comprise MRS 02 – Inaccessible Cays are owned and managed by USFWS and the reasonably anticipated future land use remains unchanged from the current land use; no development is anticipated to occur at the cays. Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance with selection of Alternative 2 since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 2 can be effective over the short- and long-term because it educates the site users of the potential explosive hazards at the cays (signs/educational programs) and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC/MPPEH, Alternative 2 would not reduce the “volume” of MEC at the cays but it would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the best ways to manage residual risk from potential MEC (whether as stand alone or in part with other remedial alternatives).

While the cays can be difficult to access depending on weather, sea conditions, and the availability of access locations, Alternative 2 can be implemented relatively easily and cost effectively by installing signs on and around public areas and by making educational material available. Costs for the remedial action and LTM (30 years) are presented in Table 4-2. Data supporting the cost estimates are presented in Appendix A. Overall, alternative 2 is a relatively low cost, easily implementable alternative.

Modifying Criteria. Alternative 2 may potentially satisfy the regulatory community and the public as it would provide notification to potential human receptors (trespassers) through LUCs. However, this alternative does not remove any MEC which may not be acceptable. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Decision Document.

4.2.1.3 Alternative 3 – LUCs and a Surface Removal of MEC/MPPEH Along Beaches

Alternative 3 consists of conducting a surface removal frequented areas at the cays (e.g., beaches and trails) and implementation of the same LUCs outlined in Alternative 2. Surface removals in will be conducted in areas frequented by recreational users who trespass on the cays. While access to the cays is prohibited by the USFWS, trespassers are known to visit for recreational purposes. LUCs in the form of signs will warn of the potential explosive hazards associated with public areas of the site. Educational programs will also be put in place to notify and educate people who may access the cays. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Table 4-1.

4.2.1.3.1 Assessment

Threshold Criteria. Alternative 3 meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC and MPPEH at the ground surface would be removed in areas with current or anticipated human activity, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach areas. However, the LUCs would further reduce and help prevent exposure of human receptors to MEC/MPPEH introduced on the surface by discouraging access. Furthermore, the LUCs would educate potential human receptors of the possible hazards at the cays. The environment would incur a relatively low level of disturbance as removal activities would be restricted to the surface in areas which have limited vegetation. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 3 would be effective over the short- and long-term because it would remove MEC from the surface of select areas of the cays, which limits the direct exposure pathway and educates the site users of the potential explosive hazards (signs/educational programs/dig restrictions). There would be a slight increased short-term risk to construction workers associated with the surface removal activities. While subsurface MEC would potentially still be present at the cays, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of Alternative 2, the reduction of toxicity, mobility, and volume is generally associated with

MC. However, Alternative 3 would essentially reduce the "volume" of MEC/MPPEH on the surface in areas frequented by human receptors. LUCs would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

While the cays can be difficult to access depending on weather, sea conditions, and the availability of access locations, Alternative 3 can be implemented relatively easily using conventional MEC surface removal and disposal, and installation of LUCs. Implementation of Alternative 3 would increase the amount of time and resources for the remedy when compared with Alternative 2. Costs for the remedial action and LTM (30 years) are presented in Table 4-2. Data supporting the cost estimates are presented in Appendix A.

Modifying Criteria. Alternative 3 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through the surface removal of MEC along beaches and LUCs. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.1.4 Alternative 4 – LUCs and Surface Removal of MEC/MPPEH

Alternative 4 consists of conducting a surface removal over all of the cays and implementation of the same LUCs outlined in Alternative 2. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Table 4-1.

4.2.1.4.1 Assessment

Threshold Criteria. Alternative 4 meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC and MPPEH at the ground surface would be removed in areas with anticipated human activity and LUCs implemented for residual risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach areas. However, the LUCs would further reduce and help prevent exposure of human receptors to MEC/MPPEH introduced on the surface by discouraging access. Furthermore, the LUCs would educate potential human receptors of the possible hazards. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 4 would be effective over the short- and long-term because it would remove MEC from the surface of the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to construction workers associated with the surface removal activities over all the cays. While subsurface MEC would potentially still be present at the site, the use of LUCs would help reduce the potential interaction between human

receptors and MEC. This alternative can be considered a permanent solution in conjunction with LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of Alternative 2, the reduction of toxicity, mobility, and volume is generally associated with MC. However, Alternative 4 would essentially reduce the "volume" of MEC/MPPEH at the cays on the surface. LUCs would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

The terrain on the majority of the cays is challenging and covered in dense vegetation. In addition, the cays can be difficult to access depending on weather, sea conditions and the availability of access locations. Based on some of the adverse conditions at the cays, Alternative 4 would be implemented with moderate difficulty using conventional MEC surface removal and disposal, and installation of LUCs. Implementation of Alternative 4 would substantially increase the amount of time and resources for the remedy when compared with Alternative 2 and 3. Costs for the remedial action and LTM (30 years) are presented in Table 4-2. Data supporting the cost estimates are presented in Appendix A.

Modifying Criteria. Alternative 4 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through the subsurface removal of MEC across the entire site(s) and LUCs. Stakeholders may be concerned on potential disturbance of habitat through vegetation removal required for this alternative. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.2 MRS 02 – Cayo Lobo and MRS 07

4.2.2.1 Alternative 1 - No Action

The No Action Alternative involves taking no action at MRS – 02 Cayo Lobo and MRS 07. Under this alternative, no further effort or resources would be expended at the site. An assessment based on the NCP criteria is provided below. The summary of Alternative 1 compared to the NCP criteria is presented in Table 4-3 and Table 4-5.

4.2.2.1.1 Assessment

Threshold Criteria. Alternative 1 does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC. This alternative does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, Alternative 1 does not meet the remedial action objectives.

Balancing Criteria. Alternative 1 is not effective in the short- or long-term because no precautions would be taken to reduce potential contact with MEC/MPPEH. This alternative does not employ an action that will result in a permanent solution for the site. The reduction of toxicity, mobility, and volume generally refers to MC. However,

the "volume" of MEC/MPPEH would not be reduced with Alternative 1 since no action would be taken, nor would "toxicity" as related to exposure be reduced. This alternative is easily implementable as no actions would be taken. Alternative 1 is also the lowest cost alternative since there would be no cost associated with it.

Modifying Criteria. Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC.

4.2.2.2 Alternative 2 – Land Use Controls

Alternative 2 requires that signs be installed on and around MRS – 02 Cayo Lobo and MRS 07and that an educational program be implemented to warn of the potential explosive hazards associated with the site. Dig restrictions would also be placed on public property. A LTM plan would be required to inspect LUCs and provide educational material on a periodic basis. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-3 and 4-5.

4.2.2.2.1 Assessment

Threshold Criteria. Alternative 2 meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across MRS – 02 Cayo Lobo and MRS 07 is considered low based on the historic field activities and previous MEC finds. The area is owned and managed by USFWS and the reasonably anticipated future land use remains unchanged from the current land use; no development is anticipated to occur. Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance with selection of Alternative 2 since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 2 can be effective over the short- and long-term because it educates the site users of the potential explosive hazards at MRS – 02 Cayo Lobo and MRS 07 (signs/educational programs) and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC/MPPEH, Alternative 2 would not reduce the "volume" of MEC but it would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the

best ways to manage residual risk from potential MEC (whether as stand alone or in part with other remedial alternatives).

Alternative 2 can be implemented relatively easily and cost effectively by installing signs on and around public areas and by making educational material available. Costs for the remedial action and LTM (30 years) are presented in Tables 4-4 and 4-6. Data supporting the cost estimates are presented in Appendix A. Overall, alternative 2 is a relatively low cost, easily implementable alternative.

Modifying Criteria. Alternative 2 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through LUCs. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.2.3 Alternative 3 – LUCs and a Surface/Subsurface Removal of MEC/MPPEH within Frequented Areas Only

Alternative 3 consists of conducting a surface and subsurface removal frequented areas at MRS – 02 Cayo Lobo and MRS 07 (e.g., beaches and trails) and implementation of the same LUCs outlined in Alternative 2. Subsurface removals will be conducted in areas frequented by recreational users. A limited subsurface removal took place on MRS07 along the Culebrita beaches; however, due to the dynamic nature of a beach environment and the potential for erosion and items to wash ashore over time, a subsurface removal for the beaches at Culebrita is considered as one alternative. LUCs in the form of signs will warn of the potential explosive hazards associated with public areas of the site. Educational programs will also be put in place to notify and educate people who may visit MRS – 02 Cayo Lobo and MRS 07. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-3 and 4-5.

4.2.2.3.1 Assessment

Threshold Criteria. Alternative 3 meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC and MPPEH at the ground surface and in the subsurface would be removed in areas with current or anticipated human activity, and LUCs would be implemented for risk management. LUCs would reduce and help prevent exposure of human receptors to any residual MEC/MPPEH. Furthermore, the LUCs would educate potential human receptors of the possible hazards at MRS – 02 Cayo Lobo and MRS 07. The environment would incur a relatively low level of disturbance as removal activities would be restricted to areas which have limited vegetation. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 3 would be effective over the short- and long-term because it would remove MEC from the surface and subsurface of select areas, which limits the direct exposure pathway and educates the site users of the potential explosive

hazards (signs/educational programs/dig restrictions). There would be a slight increased short-term risk to construction workers associated with the removal activities. The use of LUCs would help reduce the potential interaction between human receptors and any residual MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of Alternative 2, the reduction of toxicity, mobility, and volume is generally associated with MC. However, Alternative 3 would essentially reduce the "volume" of MEC/MPPEH on the surface in areas frequented by human receptors. LUCs would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

While Culebrita and Cayo Lobo can be difficult to access depending on weather and sea conditions, Alternative 3 can be implemented relatively easily using conventional MEC removal and disposal, and installation of LUCs. Implementation of Alternative 3 would increase the amount of time and resources for the remedy when compared with Alternative 2. Costs for the remedial action and LTM (30 years) are presented in Tables 4-4 and 4-6. Data supporting the cost estimates are presented in Appendix A.

Modifying Criteria. Alternative 3 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through the subsurface removal of MEC and LUCs. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.3 MRS 02 – Cayo Yerba, MRS 04 U.S. Fish and Wildlife Area, and MRS 05 U.S. Fish and Wildlife Area

4.2.3.1 Alternative 1 - No Action

The No Action Alternative involves taking no action at the MRS 02 – Cayo Yerba and U.S. Fish and Wildlife Areas in MRS 04 and MRS 05. Under this alternative, no further effort or resources would be expended at the site. An assessment based on the NCP criteria is provided below. The summary of Alternative 1 compared to the NCP criteria is presented in Tables 4-7 and 4-9.

4.2.3.1.1 Assessment

Threshold Criteria. Alternative 1 does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC. This alternative does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, Alternative 1 does not meet the remedial action objectives.

Balancing Criteria. Alternative 1 is not effective in the short- or long-term because no precautions would be taken to reduce potential contact with MEC/MPPEH. This

alternative does not employ an action that will result in a permanent solution for the site. The reduction of toxicity, mobility, and volume generally refers to MC. However, the "volume" of MEC/MPPEH would not be reduced with Alternative 1 since no action would be taken, nor would "toxicity" as related to exposure be reduced. This alternative is easily implementable as no actions would be taken. Alternative 1 is also the lowest cost alternative since there would be no cost associated with it.

Modifying Criteria. Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC.

4.2.3.2 Alternative 2 – Land Use Controls

Alternative 2 requires that signs be installed on and around 02 – Cayo Yerba and U.S. Fish and Wildlife Areas and that an educational program be implemented to warn of the potential explosive hazards associated with the site. Dig restrictions would also be placed on public property. A LTM plan would be required to inspect LUCs and provide educational material on a periodic basis. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-8 and 4-10.

4.2.3.2.1 Assessment

Threshold Criteria. Alternative 2 meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across MRS 02 – Cayo Yerba and U.S. Fish and Wildlife Area is considered moderate based on the historic field activities and previous MEC finds. The area is undeveloped and owned and managed by USFWS and the reasonably anticipated future land use remains unchanged from the current land use; no development is anticipated to occur. Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance with selection of Alternative 2 since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 2 can be effective over the short- and long-term because it educates the site users of the potential explosive hazards at MRS 02 – Cayo Yerba and U.S. Fish and Wildlife Area (signs/educational programs) and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC/MPPEH, Alternative 2 would not reduce the "volume" of MEC but it would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain

on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the best ways to manage residual risk from potential MEC (whether as stand alone or in part with other remedial alternatives).

Alternative 2 can be implemented relatively easily and cost effectively by installing signs on and around public areas and by making educational material available. Costs for the remedial action and LTM (30 years) are presented in Tables 4-8 and 4-10. Data supporting the cost estimates are presented in Appendix A. Overall, alternative 2 is a relatively low cost, easily implementable alternative.

Modifying Criteria. Alternative 2 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through LUCs. However, there may be concern that no MEC would be removed under this alternative. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.3.3 Alternative 3 – LUCs and a Surface Removal of MEC/MPPEH within Frequented Areas Only

Alternative 3 consists of conducting a surface removal frequented areas at MRS 02 – Cayo Yerba and U.S. Fish and Wildlife Areas (e.g., beaches and trails) and implementation of the same LUCs outlined in Alternative 2. Surface removals in will be conducted in areas frequented by recreational users. LUCs in the form of signs will warn of the potential explosive hazards associated with public areas of the site. Educational programs will also be put in place to notify and educate people who may visit MRS 02 – Cayo Yerba and U.S. Fish and Wildlife Area. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-7 and 4-9.

4.2.3.3.1 Assessment

Threshold Criteria. Alternative 3 meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC and MPPEH at the ground surface would be removed in areas with current or anticipated human activity, and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion or storm surge in beach areas. However, the LUCs would further reduce and help prevent exposure of human receptors to MEC/MPPEH introduced on the surface by discouraging access. Furthermore, the LUCs would educate potential human receptors of the possible hazards at MRS 02 – Cayo Yerba and U.S. Fish and Wildlife Area. The environment would incur a relatively low level of disturbance as removal activities would be restricted to the surface in areas which have limited vegetation. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 3 would be effective over the short- and long-term because it would remove MEC from the surface of select areas, which limits the direct

exposure pathway and educates the site users of the potential explosive hazards (signs/educational programs/dig restrictions). There would be a slight increased short-term risk to construction workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of Alternative 2, the reduction of toxicity, mobility, and volume is generally associated with MC. However, Alternative 3 would essentially reduce the "volume" of MEC/MPPEH on the surface in areas frequented by human receptors. LUCs would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

Alternative 3 can be implemented relatively easily using conventional MEC surface removal and disposal, and installation of LUCs. Implementation of Alternative 3 would increase the amount of time and resources for the remedy when compared with Alternative 2. Costs for the remedial action and LTM (30 years) are presented in Tables 4-8 and 4-10. Data supporting the cost estimates are presented in Appendix A.

Modifying Criteria. Alternative 3 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through the surface removal of MEC in frequented area and LUCs. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.3.4 Alternative 4 – LUCs and a Subsurface Removal of MEC/MPPEH within Frequented Areas Only

Alternative 4 consists of conducting a surface removal over all of MRS 02 – Cayo Yerba and U.S. Fish and Wildlife Areas and implementation of the same LUCs outlined in Alternative 2. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-7 and 4-9.

4.2.3.4.1 Assessment

Threshold Criteria. Alternative 4 meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC and MPPEH at the ground surface would be removed in areas with anticipated human activity and LUCs implemented for residual risk management. LUCs would reduce and help prevent exposure of human receptors to any residual MEC/MPPEH. Furthermore, the LUCs would educate potential human receptors of the possible hazards. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 4 would be effective over the short- and long-term because it would remove MEC from the surface of the site, which limits the direct exposure pathways to human and ecological receptors. There would be a slight increased short-term risk to construction workers associated with the surface removal activities. The use of LUCs would help reduce the potential interaction between human receptors and any residual MEC. This alternative can be considered a permanent solution in conjunction with LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of Alternative 2, the reduction of toxicity, mobility, and volume is generally associated with MC. However, Alternative 4 would essentially reduce the "volume" of MEC/MPPEH on the surface. LUCs would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

While Cayo Yerba can be difficult to access depending on weather and sea conditions, Alternative 4 would be implemented with moderate difficulty using conventional MEC surface removal and disposal, and installation of LUCs. Implementation of Alternative 4 would substantially increase the amount of time and resources for the remedy when compared with Alternative 2 and 3. Costs for the remedial action and LTM (30 years) are presented in Tables 4-8 and 4-10. Data supporting the cost estimates are presented in Appendix A.

Modifying Criteria. Alternative 4 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through the subsurface removal of MEC in frequented area and LUCs. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.4 MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)

4.2.4.1 Alternative 1 - No Action

The No Action Alternative involves taking no action at MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands). Under this alternative, no further effort or resources would be expended at the site. An assessment based on the NCP criteria is provided below. The summary of Alternative 1 compared to the NCP criteria is presented in Tables 4-11, 4-13, and 4-15.

4.2.4.1.1 Assessment

Threshold Criteria. Alternative 1 does not meet the threshold factor since no action would be taken to reduce the risk of potential receptor exposure to MEC. This alternative does not offer protection of human health and the environment. Since no actions would be taken, an assessment of ARARs is not appropriate. Additionally, Alternative 1 does not meet the remedial action objectives.

Balancing Criteria. Alternative 1 is not effective in the short- or long-term because no precautions would be taken to reduce potential contact with MEC/MPPEH. This alternative does not employ an action that will result in a permanent solution for the site. The reduction of toxicity, mobility, and volume generally refers to MC. However, the "volume" of MEC/MPPEH would not be reduced with Alternative 1 since no action would be taken, nor would "toxicity" as related to exposure be reduced. This alternative is easily implementable as no actions would be taken. Alternative 1 is also the lowest cost alternative since there would be no cost associated with it.

Modifying Criteria. Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC.

4.2.4.2 Alternative 2 – Land Use Controls

Alternative 2 requires that signs be installed on and around the MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)(public property only) and that an educational program for residents, workers, and visitors be implemented to warn of the potential explosive hazards associated with the site. Dig restrictions would also be placed on public property. A LTM plan would be required to inspect LUCs and provide educational material on a periodic basis. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-11, 4-13, and 4-15.

4.2.4.2.1 Assessment

Threshold Criteria. Alternative 2 meets the threshold criteria and would provide for reasonable protection to potential human receptors based on the results of the RI field activities and future anticipated land use of the site. MEC density across MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)is considered moderate based on the historic field activities and previous MEC finds. While the majority of MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)is undeveloped with some residential areas, it is conservatively assumed that residential use is a reasonably anticipated future land use over the entirety of MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands). Although this alternative would not remove any MEC from the site, this alternative will increase awareness of human receptors to the potential explosives hazards at the site and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. This alternative does not address ecological receptors; however, the risk to ecological receptors is considered low for MEC. The environment would incur a low level of disturbance with selection of Alternative 2 since minimal activities would be required. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 2 can be effective over the short- and long-term because it educates the site users of the potential explosive hazards at MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands) (signs/educational programs)

and limits the potential for receptors to encounter MEC in the subsurface by establishing dig restrictions on public property. The reduction of toxicity, mobility, and volume is generally associated with MC. However, if applied towards MEC/MPPEH, Alternative 2 would not reduce the "volume" of MEC at MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)but it would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors) by limiting exposure pathways through education and dig restrictions. Based on the nature of the hazard (explosive), residual MEC risk will remain on site regardless of which remedial alternatives are implemented. LUCs and a LTM plan are typically the best ways to manage residual risk from potential MEC (whether as stand alone or in part with other remedial alternatives).

Alternative 2 can be implemented relatively easily and cost effectively by installing signs on and around MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands) (public areas) and by hosting education meetings with residents and by making educational material available for workers and visitors. Costs for the remedial action and LTM (30 years) are presented in Tables 4-12, 4-14, and 4-16. Data supporting the cost estimates are presented in Appendix A. Overall, alternative 2 is a relatively low cost, easily implementable alternative.

Modifying Criteria. Alternative 2 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through LUCs. However, there may be concern since no MEC would be removed under this alternative. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.4.3 Alternative 3 – LUCs and Surface Removal of MEC/MPPEH from accessible portions of the Subarea

Alternative 3 consists of conducting a surface removal over accessible portions of MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands), and implementation of the same LUCs outlined in Alternative 2. Inaccessible areas are characterized by steep/hazardous slopes, thick vegetation, and/or non-compliance with ARARs. LUCs in the form of signs will warn of the potential explosive hazards associated with public areas of the site. Educational programs will also be put in place to notify and educate the public and residents and dig restriction will be enacted on public property. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-11, 4-13, and 4-15.

4.2.4.3.1 Assessment

Threshold Criteria. Alternative 3 meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC and MPPEH at the ground surface would be removed and LUCs would be implemented for risk management. There is a residual risk of MEC surfacing through mechanisms such as erosion. However, the LUCs would further reduce and help prevent exposure of human

receptors to MEC/MPPEH in the subsurface or introduced on the surface by discouraging access. Furthermore, the LUCs would educate potential human receptors of the possible hazards at MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands). The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 3 would be effective over the short- and long-term because it would remove MEC from the surface of select areas of MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands), which limits the direct exposure pathway and educates the site users of the potential explosive hazards (signs/educational programs/dig restrictions). There would be a slight increased short-term risk to construction workers associated with the surface removal activities. While subsurface MEC would potentially still be present, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution primarily because of the LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of Alternative 2, the reduction of toxicity, mobility, and volume is generally associated with MC. However, Alternative 3 would essentially reduce the "volume" of MEC/MPPEH on the surface. LUCs would reduce the effective "toxicity" (potential of MEC to result in physical harm to receptors).

Alternative 3 can be implemented relatively easily using conventional MEC surface removal and disposal, and installation of LUCs. Implementation of Alternative 3 would increase the amount of time and resources for the remedy when compared with Alternative 2. Costs for the remedial action and LTM (30 years) are presented in Tables 4-12, 4-14, and 4-16. Data supporting the cost estimates are presented in Appendix A.

Modifying Criteria. Alternative 3 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through the surface removal and LUCs. Concern that MEC would remain in the subsurface is a potential concern. Disturbance of habitat through vegetation removal is another potential concern. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

4.2.4.4 Alternative 4 – LUCs and Subsurface Removal of MEC/MPPEH from accessible portions of the Subarea

Alternative 4 consists of conducting a subsurface removal over accessible portions of MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands) and implementation of the same LUCs outlined in Alternative 2. Inaccessible areas are characterized by steep/hazardous slopes, thick vegetation, and/or non-compliance with

ARARs. An assessment based on the NCP criteria is provided below. The summary of Alternative 2 compared to the NCP criteria is presented in Tables 4-11, 4-13, and 4-15.

4.2.4.4.1 Assessment

Threshold Criteria. Alternative 4 meets the threshold criteria and would provide reasonable protection to potential human and ecological receptors since MEC and MPPEH at the ground surface and subsurface would be removed and LUCs implemented for residual risk management. LUCs would reduce and help prevent exposure of human receptors to any residual MEC/MPPEH. Furthermore, the LUCs would educate potential human receptors of the possible hazards and limit the potential for receptors to contact MEC in the subsurface where dig restrictions are in place. The environment would incur a relatively high level of disturbance as removal activities would be conducted over the entire site requiring substantial brush and tree removal. The subsurface removal activities would only include small hand dug holes which would be filled when the investigation was complete and any anomalies removed. This alternative would comply with the applicable ARARs listed in Section 2 of this FS.

Balancing Criteria. Alternative 4 would be effective over the short- and long-term because it would remove MEC from the surface of the site, which limits the direct exposure pathways to human and ecological receptors. In addition, subsurface MEC would be removed at MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands). There would be a slight increased short-term risk to construction workers associated with the surface and subsurface removal activities. While subsurface MEC would potentially still be present at the site, the use of LUCs would help reduce the potential interaction between human receptors and MEC. This alternative can be considered a permanent solution in conjunction with LUCs and associated LTM plan. As previously discussed, residual risk from MEC over the short and long-term can be managed by appropriate site management. As stated in the analysis of Alternative 2, the reduction of toxicity, mobility, and volume is generally associated with MC. However, Alternative 4 would essentially reduce the “volume” of MEC/MPPEH on the surface and in the subsurface. LUCs would reduce the effective “toxicity” (potential of MEC to result in physical harm to receptors).

Alternative 4 would be implemented relatively easily using conventional MEC surface and subsurface removal, disposal, and installation of LUCs. Implementation of Alternative 4 would substantially increase the amount of time and resources for the remedy when compared with Alternative 2 and 3. Costs for the remedial action and LTM (30 years) are presented in Tables 4-12, 4-14, and 4-16. Data supporting the cost estimates are presented in Appendix A.

Modifying Criteria. Alternative 4 may potentially satisfy the regulatory community and the public as it would provide reasonable protection to potential human receptors through the subsurface removal and LUCs. Disturbance of habitat through vegetation removal may be a greater stakeholder concern with subsurface removal. Regulatory

and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-1 – NCP Criteria for MRS 02 – Inaccessible Cays		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 – Inaccessible Cays.
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $334,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Surface Removal of MEC/MPPEH Along Beaches Only**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface removal.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Limited access to cays reduces implementability.
	Cost Estimate	Total cost is $397,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs and a Surface Removal of MEC/MPPEH**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques. Limited access to cays reduces implementability.
	Cost Estimate	Total cost is $944,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-2: Remedial Alternatives Cost Summary for MRS 02 – Inaccessible Cays

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$109,000	$225,000	$334,000
3	LUCs and a Surface Removal in Frequented Area (e.g., beaches)	$172,000	$225,000	$397,000
4	LUCs and a Surface Removal of the entire Subarea	$719,000	$225,000	$944,000

Table 4-3 – NCP Criteria for MRS 02 – Cayo Lobo		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 – Cayo Lobo
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $210,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Subsurface Removal in Frequented Area (e.g., beaches and trails).**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface and subsurface clearance techniques.
	Cost Estimate	Total cost is $269,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-4: Remedial Alternatives Cost Summary for MRS 02 – Cayo Lobo

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$89,000	$121,000	$210,000
3	LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)	$148,000	$121,000	$269,000

Table 4-5 – NCP Criteria for MRS 07		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 07.
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $334,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques.
	Cost Estimate	Total cost is $442,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-6: Remedial Alternatives Cost Summary for MRS 07

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$109,000	$225,000	$334,000
3	LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)	$217,000	$225,000	$442,000

Table 4-7– NCP Criteria for MRS 02 – Cayo Yerba		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 - Cayo Yerba.
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 - Cayo Yerba.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $210,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface clearance techniques.
	Cost Estimate	Total cost is $259,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs and a Subsurface Removal in Frequented Area (e.g., beaches and trails)**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface and subsurface clearance techniques.
	Cost Estimate	Total cost is $269,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-8: Remedial Alternatives Cost Summary for MRS 02 – Cayo Yerba

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$89,000	$121,000	$210,000
3	LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)	$138,000	$121,000	$259,000
4	LUCs and a Subsurface Removal in Frequented Area (e.g., beaches and trails)	$148,000	$121,000	$269,000

Table 4-9– NCP Criteria for the MRS 04 U.S. Fish and Wildlife Area		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at U.S. Fish and Wildlife Area.
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $334,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques.
	Cost Estimate	Total cost is $379,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs and a Subsurface Removal in Frequented Area (e.g., beaches and trails)**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques.
	Cost Estimate	Total cost is $414,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-10: Remedial Alternatives Cost Summary for the MRS 04 U.S. Fish and Wildlife Area

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$109,000	$225,000	$334,000
3	LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)	$154,000	$225,000	$379,000
4	LUCs and a Subsurface Removal in Frequented Area (e.g., beaches and trails)	$189,000	$225,000	$414,000

Table 4-11– NCP Criteria for the MRS 05 U.S. Fish and Wildlife Area		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at U.S. Fish and Wildlife Area.
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $334,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques.
	Cost Estimate	Total cost is $425,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs and a Subsurface Removal in Frequented Area (e.g., beaches and trails)**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional surface clearance techniques.
	Cost Estimate	Total cost is $547,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-11: Remedial Alternatives Cost Summary for the MRS 05 U.S. Fish and Wildlife Area

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$109,000	$225,000	$334,000
3	LUCs and a Surface Removal in Frequented Area (e.g., beaches and trails)	$200,000	$225,000	$425,000
4	LUCs and a Subsurface Removal in Frequented Area (e.g., beaches and trails)	$322,000	$225,000	$547,000

Table 4-13– NCP Criteria for MRS 02 - Cerro Balcon		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 – Cerro Balcon.
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $334,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and Surface Removal**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface clearance techniques.
	Cost Estimate	Total cost is $569,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs and Subsurface Removal**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface and subsurface clearance techniques.
	Cost Estimate	Total cost is $729,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-14: Remedial Alternatives Cost Summary for MRS 02 - Cerro Balcon

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$109,000	$225,000	$334,000
3	LUCs and a Surface Removal from the entire Subarea	$344,000	$225,000	$569,000
4	LUCs and a subsurface Removal from the entire Subarea	$504,000	$225,000	$729,000

Table 4-15– NCP Criteria for MRS 04 (remaining lands)		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 04 (remaining lands).
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $654,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Surface Removal**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface clearance techniques.
	Cost Estimate	Total cost is $1,395,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs and a Subsurface Removal**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface and subsurface clearance techniques.
	Cost Estimate	Total cost is $1,723,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-16: Remedial Alternatives Cost Summary for MRS 04 (remaining lands)

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$291,000	$363,000	$654,000
3	LUCs and a Surface Removal from the entire Subarea	$1,032,000	$363,000	$1,395,000
4	LUCs and a Subsurface Removal from the entire Subarea	$1,360,000	$363,000	$1,723,000

Table 4-17– NCP Criteria for MRS 05 (remaining lands)		
Criteria		**Alternative 1: No Action**
Threshold Criteria	Overall Protection of Human Health and the Environment	Not protective of human health or the environment because it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 05 (remaining lands).
	Compliance with ARARs	No action, thus, ARARs not applicable.
Primary Balancing Criteria	Short-term Effectiveness	Does not meet short-term effectiveness requirements (does not remove MEC/MPPEH.)
	Long-term Effectiveness	Does not meet long-term effectiveness requirements (does not remove MEC/MPPEH.)
	Reduction of Toxicity, Mobility, Volume	Does not reduce toxicity, mobility, or volume because no remediation takes place.
	Implementability	Highly implementable because no remedial action.
	Cost Estimate	No cost is associated with this alternative because no action would be taken.
Modifying Criteria	Regulatory and Community Acceptance	Will not satisfy either the regulatory community or the public as there would be no actions taken.
Criteria		**Alternative 2: Land Use Controls**
Threshold Criteria	Overall Protection of Human Health and the Environment	Reduces the potential impact to human health through education of risks and limitation of access to potential human receptors.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Reduces the short-term potential for human receptor interaction with MEC at the site.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Reduces the potential for human receptor exposure to MEC risks. Does not reduce volume of MEC.
	Implementability	Highly implementable because the cost to implement is low and specialized equipment or personnel are not required.
	Cost Estimate	Total cost is $897,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 3: LUCs and a Surface Removal**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface clearance techniques.
	Cost Estimate	Total cost is $3,775,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.
Criteria		**Alternative 4: LUCs and a Subsurface Removal**
Threshold Criteria	Overall Protection of Human Health and the Environment	Would be protective of human health and most ecological receptors since it removes the direct contact pathway between potential receptors and MEC.
	Compliance with ARARs	Would comply with the applicable ARARs as defined in this document.
Primary Balancing Criteria	Short-term Effectiveness	Increase in short-term risk to construction workers associated with completing the surface and subsurface clearance.
	Long-term Effectiveness	Reduces the long-term potential for human receptor interaction with MEC at the site.
	Reduction of Toxicity, Mobility, and Volume	Effective at reducing the volume of MEC on the surface and subsurface. LUCs reduce the exposure risk to human receptors.
	Implementability	Implementable using conventional MEC surface and subsurface clearance techniques.
	Cost Estimate	Total cost is $7,159,000
Modifying Criteria	Regulatory and Community Acceptance	May potentially satisfy the regulatory community and the public. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Table 4-18: Remedial Alternatives Cost Summary for MRS 05 (remaining lands)

Alternative Number	Description	Capital Costs	Annual Costs	Total Cost
1	No Action	$0	$0	$0
2	Land Use Controls	$465,000	$432,000	$897,000
3	LUCs and a Surface Removal from the entire Subarea	$3,343,000	$432,000	$3,775,000
4	LUCs and a Subsurface Removal from the entire Subarea	$6,727,000	$432,000	$7,159,000

Table 4-19: Remedial Alternatives Cost Summary by MRS

MRS	Alternative 1 Total Costs	Alternative 2 Total Costs	Alternative 3 Total Costs	Alternative 4 Total Costs
02	No Action: $0	LUCs only: $1,088,000	Surface Removal on Beaches and LUCs (Inaccessible Cays): $397,000 Surface/Subsurface Removal on Beaches and LUCs (Cayo Lobo): $269,000 Surface Removal on Beaches and LUCs (Cayo Yerba): $259,000 Complete Surface Removal and LUCs (Cerro Balcon): $569,000 TOTAL: $1,494,000	Complete Surface Removal and LUCs (Inaccessible Cays): $944,000 Surface/Subsurface Removal on Beaches and LUCs (Cayo Yerba): $269,000 Complete Surface/Subsurface Removal and LUCs (Cerro Balcon): $729,000 TOTAL: $1,942000
04	No Action: $0	LUCs only: $687,400	Surface Removal on beaches/trails (USFWS Area): $379,000 Complete Surface Removal and LUCs (Remaining Lands): $1,395,000 TOTAL: $1,774,000	Surface/Subsurface Removal on beaches/trails (USFWS Area): $414,000 Complete Surface/Subsurface Removal and LUCs (Remaining Lands): $1,723,000 TOTAL: $2,137,000
05	No Action: $0	LUCs only: $1,197,600	Surface Removal on beaches/trails (USFWS Area): $425,000 Complete Surface Removal and LUCs (Remaining Lands): $3,775,000 TOTAL: $4,200,000	Surface/Subsurface Removal on beaches/trails (USFWS Area): $547,000 Complete Surface/Subsurface Removal and LUCs (Remaining Lands): $7,159,000 TOTAL: $7,706,000
07	No Action: $0	LUCs only: $334,000	Surface Removal on beaches/trail and LUCs: $442,000	N/A

4.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

The comparison of the alternatives is based on the threshold, balancing, and modifying criteria that consider effectiveness at protecting human health and the environment; compliance with ARARs; short- and long-term effectiveness; reduction of toxicity, mobility, and volume through treatment; implementability; cost; and regulatory and community acceptance.

4.3.1 MRS 02 – Inaccessible Cays (Los Gemelos, Cayo Lobitto, Cayo Raton, Cayo Del Aqua, Cayo Ballena, Cayo Geniqui, and Cayo Sombrerito)

4.3.1.1 Protectiveness

Alternative 1 does not meet this threshold criterion since it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 – Inaccessible Cays. Alternative 2 is protective of human health by reducing the potential interaction with MEC through the establishment of LUCs. Both Alternatives 3 and 4 are protective of human health because they remove the direct contact pathway between potential receptors and MEC on the ground surface.

4.3.1.2 Compliance with ARARs

ARARs are not identified for the no action alternative. Alternatives 2, 3, and 4 would comply with ARARs identified with MRS 02 – Inaccessible Cays; however, impacts related to vegetation removal would have to be carefully addressed under Alternatives 3 and 4 to ensure compliance with action-specific and location-specific ARARs.

4.3.1.3 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 does not reduce the volume of MEC as there is no action taken. Alternative 2 does not reduce the volume of MEC/MPPEH at the site; however, it reduces the potential for human exposure to MEC risks. Alternative 3 and 4 would potentially reduce the volume of MEC/MPPEH through a surface removal, if any is present. Alternative 4 would potentially provide the greatest reduction in MEC as a surface removal would be conducted over the entire site and not only in the frequented areas addressed in Alternative 3. However, there is a residual risk of MEC even following a removal action and therefore LUCs and LTM would still be required.

4.3.1.4 Short-Term Effectiveness

Alternative 1 does not meet this balancing criterion because no actions would be taken in the short-term to offer protectiveness of human health. Alternative 2 reduces the short-term potential for human receptor interaction with MEC at the site and has no short-term risk associated with it. Alternatives 3 and 4 are more effective in the short-term but increase the short-term risk to workers completing the surface removals, respectfully.

4.3.1.5 Long-Term Effectiveness

Alternative 1 does not meet this balancing criterion because no actions would be taken in the long-term to offer protectiveness. Alternatives 2, 3, and 4 offer long-term effectiveness for reducing the potential for human receptor interaction with MEC at the site. However, LUCs would still be required in the future along with LTM.

4.3.1.6 Implementability

Alternative 1 presents no implementation risks. Alternative 2 is the most feasible, as all of the proposed LUCs are easy to implement. Alternatives 3 and 4 are feasible using conventional MEC surface removal techniques; however, Alternatives 2, 3, and 4 are increasingly less feasible due to the difficulty in gaining access to the cays. Alternatives 3 and 4 are the most difficult to implement as they would require a large amount of vegetation removal in addition to the access issues related to the cays.

4.3.1.7 Cost

There are no costs for Alternative 1. Alternative 2 is less costly than Alternatives 3 and 4 while still protective of human health. Alternative 4 is the most costly.

4.3.1.8 Regulatory and Community Acceptance

Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC. Alternatives 2, 3, and 4 may potentially satisfy the regulatory community and the public as they would provide reasonable protection to potential human receptors through varying combinations of LUCs and removal actions. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Alternative 2 provides benefits over Alternatives 3 and 4, as Alternative 2 can be implemented relatively quickly without the need for vegetation removal and at a lower cost.

4.3.2 MRS 02 – Cayo Lobo and MRS 07

4.3.2.1 Protectiveness

Alternative 1 does not meet this threshold criterion since it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 – Cayo Lobo and MRS 07. Alternative 2 is protective of human health by reducing the potential interaction with MEC through the establishment of LUCs. Alternative 3 is protective of human health because the direct contact pathway between potential receptors and MEC on the ground surface and in the subsurface is removed, respectfully.

4.3.2.2 Compliance with ARARs

ARARs are not identified for the no action alternative. Alternatives 2 and 3 would comply with ARARs identified with MRS 02 – Cayo Lobo and MRS 07; however, impacts related to vegetation removal would have to be carefully addressed under Alternative 3 to ensure compliance with action-specific and location-specific ARARs.

4.3.2.3 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 does not reduce the volume of MEC as there is no action taken. Alternative 2 does not reduce the volume of MEC/MPPEH at the site; however, it reduces the potential for human exposure to MEC risks. Alternative 3 would reduce the volume of MEC/MPPEH through a surface and subsurface removal, if any is present. Alternative 3 would potentially provide the greatest reduction in MEC as a surface and subsurface removal would be conducted. However, there is a residual risk of MEC even following a removal action and therefore LUCs and LTM would still be required.

4.3.2.4 Short-Term Effectiveness

Alternative 1 does not meet this balancing criterion because no actions would be taken in the short-term to offer protectiveness of human health. Alternative 2 reduces the short-term potential for human receptor interaction with MEC at the site and has no short-term risk associated with it. Alternative 3 is effective in the short-term but increases the short-term risk to workers completing the surface and subsurface removals.

4.3.2.5 Long-Term Effectiveness

Alternative 1 does not meet this balancing criterion because no actions would be taken in the long-term to offer protectiveness. Alternatives 2 and 3 offer long-term effectiveness for reducing the potential for human receptor interaction with MEC at the site. However, LUCs would still be required in the future along with LTM.

4.3.2.6 Implementability

Alternative 1 presents no implementation risks. Alternative 2 is the most feasible, as all of the proposed LUCs are easy to implement. Alternative 3 is feasible using conventional MEC removal techniques.

4.3.2.7 Cost

There are no costs for Alternative 1. Alternative 2 is less costly than Alternative 3 while still protective of human health.

4.3.2.8 Regulatory and Community Acceptance

Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC. Alternatives 2 and 3 may potentially satisfy the regulatory community and the public as they would

provide reasonable protection to potential human receptors through varying combinations of LUCs and removal actions. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Alternative 3 provides benefits over other alternatives, as Alternative 3 can be implemented relatively quickly and provides a reduction of MEC in areas more likely to be accessed by humans.

4.3.3 Cayo Yerba and U.S. Fish and Wildlife Area

4.3.3.1 Protectiveness

Alternative 1 does not meet this threshold criterion since it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH either MRS – Cayo Yerba ot the U.S. Fish and Wildlife Area. Alternative 2 is protective of human health by reduces the potential interaction with MEC through the establishment of LUCs. Both Alternatives 3 and 4 are protective of human health because they remove the direct contact pathway between potential receptors and MEC on the ground surface.

4.3.3.2 Compliance with ARARs

ARARs are not identified for the no action alternative. Alternatives 2, 3, and 4 would comply with ARARs identified with the MRS – Cayo Yerba ot the U.S. Fish and Wildlife Area; however, impacts related to vegetation removal would have to be carefully addressed under Alternatives 3 and 4 to ensure compliance with action-specific and location-specific ARARs.

4.3.3.3 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 does not reduce the volume of MEC as there is no action taken. Alternative 2 does not reduce the volume of MEC/MPPEH at the site; however, it reduces the potential for human exposure to MEC risks. Alternative 3 and 4 would potentially reduce the volume of MEC/MPPEH through a surface and/or subsurface removal, if any is present. Alternative 4 would potentially provide the greatest reduction in MEC as a subsurface removal would be conducted over the frequented areas. However, there is a residual risk of MEC even following a removal action and therefore LUCs and LTM would still be required.

4.3.3.4 Short-Term Effectiveness

Alternative 1 does not meet the balancing criteria because no actions would be taken in the short-term to offer protectiveness of human health. Alternative 2 reduces the short-term potential for human receptor interaction with MEC at the site and has no short-term risk associated with it. Alternatives 3 and 4 are more effective in the short-term but increase the short-term risk to workers completing the removal actions, respectfully.

4.3.3.5 Long-Term Effectiveness

Alternative 1 does not meet this balancing criterion because no actions would be taken in the long-term to offer protectiveness. Alternatives 2, 3, and 4 offer long-term effectiveness for reducing the potential for human receptor interaction with MEC at the site. However, LUCs would still be required in the future along with LTM.

4.3.3.6 Implementability

Alternative 1 presents no implementation risks. Alternative 2 is feasible, as all of the proposed LUCs are easy to implement. Alternatives 3 and 4 are feasible using conventional MEC removal techniques.

4.3.3.7 Cost

There are no costs for Alternative 1. Alternative 2 is less costly than Alternatives 3 and 4 while still protective of human health. Alternative 4 is the most costly.

4.3.3.8 Regulatory and Community Acceptance

Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC. Alternatives 2, 3, and 4 may potentially satisfy the regulatory community and the public as they would provide reasonable protection to potential human receptors through varying combinations of LUCs and removal actions. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Alternative 3 provides benefits over Alternative 2 and 4, as Alternative 3 can be implemented relatively quickly and is less costly than Alternative 4 and provides a greater reduction of MEC in areas more likely to be accessed by humans than Alternative 2.

4.3.4 MRS 02 – Cerro Balcon, MRS 04 (remaining lands), and MRS 05 (remaining lands)

4.3.4.1 Protectiveness

Alternative 1 does not meet this threshold criterion since it does not mitigate the potential risk associated with the potential presence of MEC/MPPEH at MRS 02 – Cerro Balcon, MRS 04 (remaining lands), or MRS 05 (remaining lands). Alternative 2 is protective of human health by reduces the potential interaction with MEC through the establishment of LUCs. Both Alternatives 3 and 4 are protective of human health because they remove the direct contact pathway between potential receptors and MEC on the ground surface and in the subsurface, respectfully.

4.3.4.2 Compliance with ARARs

ARARs are not identified for the no action alternative. Alternatives 2, 3, and 4 would comply with ARARs identified with all three subareas; however, impacts related to vegetation removal would have to be carefully addressed under Alternatives 3 and 4 to ensure compliance with action-specific and location-specific ARARs.

4.3.4.3 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 does not reduce the volume of MEC as there is no action taken. Alternative 2 does not reduce the volume of MEC/MPPEH at the site; however, it reduces the potential for human exposure to MEC risks. Alternative 3 and 4 would potentially reduce the volume of MEC/MPPEH through a surface and subsurface removal, if any is present. Alternative 4 would potentially provide the greatest reduction in MEC as a surface and subsurface removal would be conducted. However, there is a residual risk of MEC even following a removal action and therefore LUCs and LTM would still be required.

4.3.4.4 Short-Term Effectiveness

Alternative 1 does not meet this balancing criterion because no actions would be taken in the short-term to offer protectiveness of human health. Alternative 2 reduces the short-term potential for human receptor interaction with MEC at the site and has no short-term risk associated with it. Alternatives 3 and 4 are more effective in the short-term but increase the short-term risk to workers completing the surface and subsurface removals.

4.3.4.5 Long-Term Effectiveness

Alternative 1 does not meet this balancing criterion because no actions would be taken in the long-term to offer protectiveness. Alternatives 2, 3, and 4 offer long-term effectiveness for reducing the potential for human receptor interaction with MEC at the site. However, LUCs would still be required in the future along with LTM.

4.3.4.6 Implementability

Alternative 1 presents no implementation risks. Alternative 2 is the most feasible, as all of the proposed LUCs are easy to implement. Alternatives 3 and 4 are feasible using conventional MEC removal techniques.

4.3.4.7 Cost

There are no costs for Alternative 1. Alternative 2 is less costly than Alternatives 3 and 4 while still protective of human health. Alternative 4 is the most costly.

4.3.4.8 Regulatory and Community Acceptance

Alternative 1 will not satisfy either the regulatory community or the public as there would be no change to the risk of potential receptor exposure to MEC. Alternatives 2, 3, and 4 may potentially satisfy the regulatory community and the public as they would

provide reasonable protection to potential human receptors through varying combinations of LUCs and removal actions. Regulatory and community acceptance of the alternatives will be further evaluated and reported in the Proposed Plan and Record of Decision.

Alternative 3 provides benefits over Alternative 2 and 4, as Alternative 3 can be implemented relatively quickly and is less costly than Alternative 4 and provides a greater reduction of MEC in areas more likely to be accessed by humans than Alternative 2.

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FIGURES

Draft Final Feasibility Study Report
Culebra, PR

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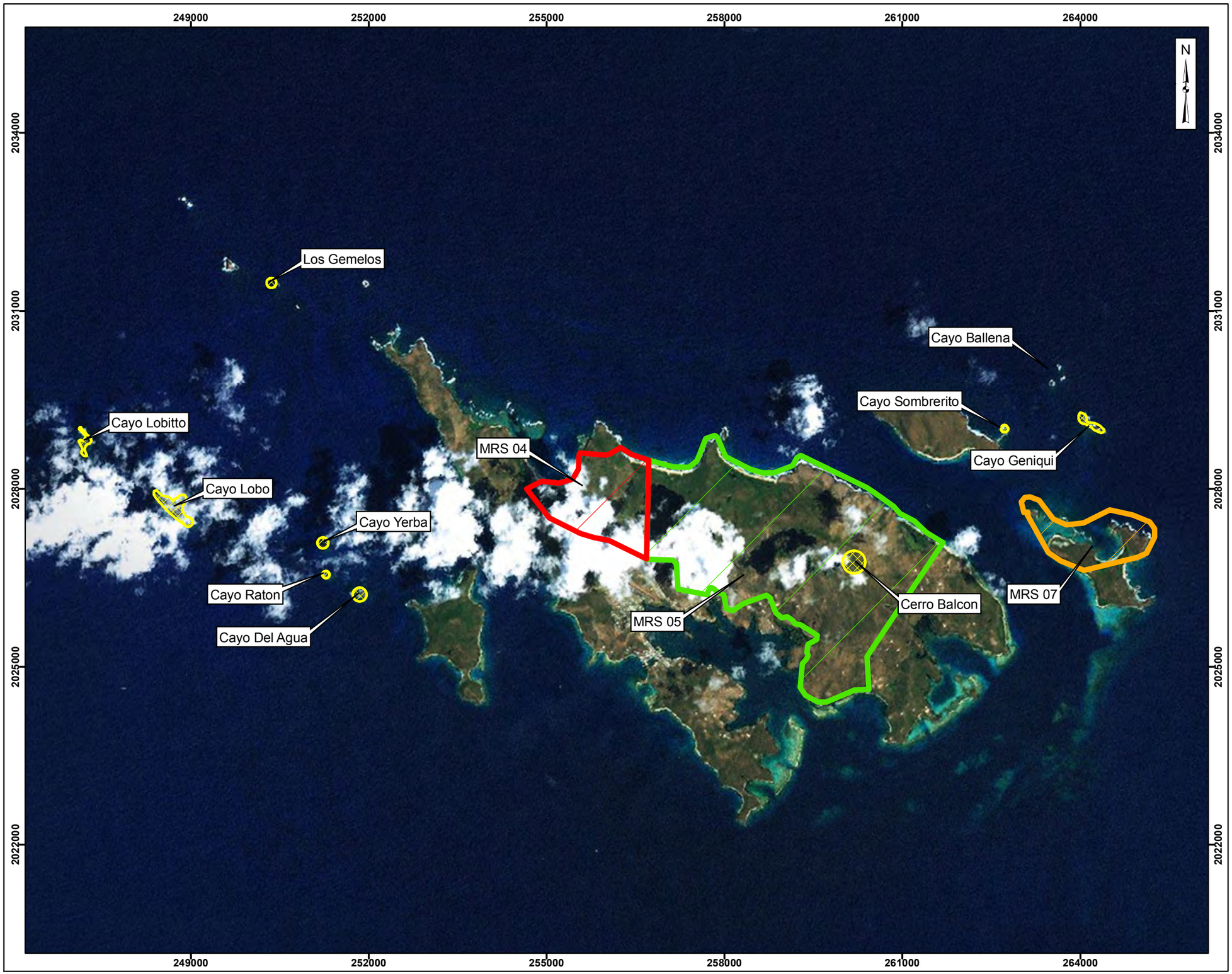
Figure 1
MRS Locations



Legend

- MRS 02 – Cerro Balcon and Adjacent Cays
- MRS 04 – Flamenco Lagoon Maneuver Area
- MRS 05 – Mortar and Combat Range Area
- MRS 07 – Culebrita Artillery Impact Area

0 1,500 3,000 Meters

Data Source: ESRI World Topo 2D, 2002
USA Prime Imagery, 2007

Coordinate System: UTM Zone 20N
Datum: NAD83
Units: Meters

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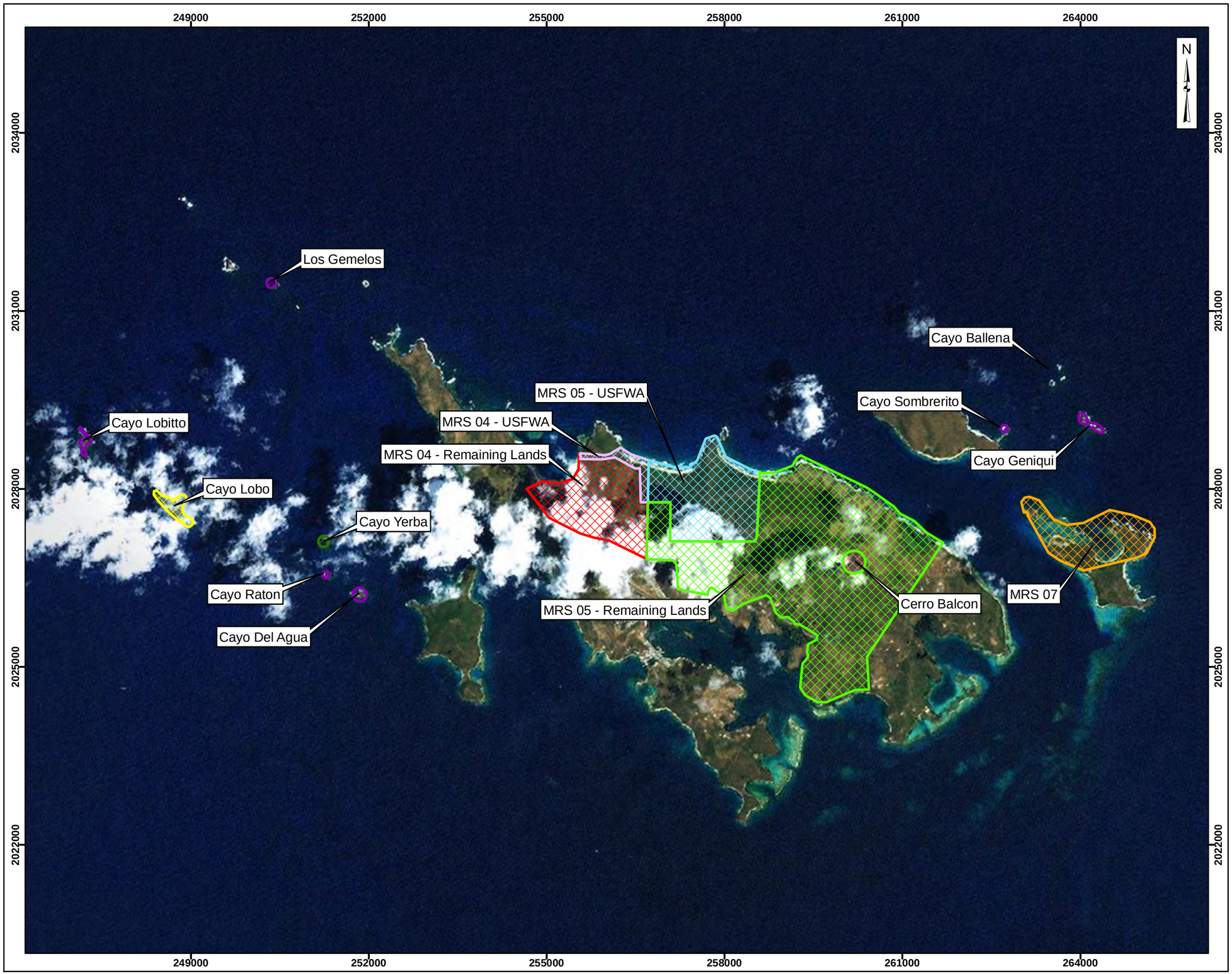
Figure 2
MRS Sub-Areas



Legend

- MRS 02 - Cayo Lobo
- MRS 02 - Cayo Yerba
- MRS 02 - Cerro Balcon
- MRS 02 - Inaccessible Cays
- MRS 04 - USFWA
- MRS 04 - Remaining Lands
- MRS 05 - USFWA
- MRS 05 - Remaining Lands
- MRS 07

0 1,500 3,000 Meters

Data Source: ESRI, World Topo 2D, 2002
ESRI, World Imagery, 1999

Coordinate System: UTM Zone 20N
Datum: NAD83
Units: Meters

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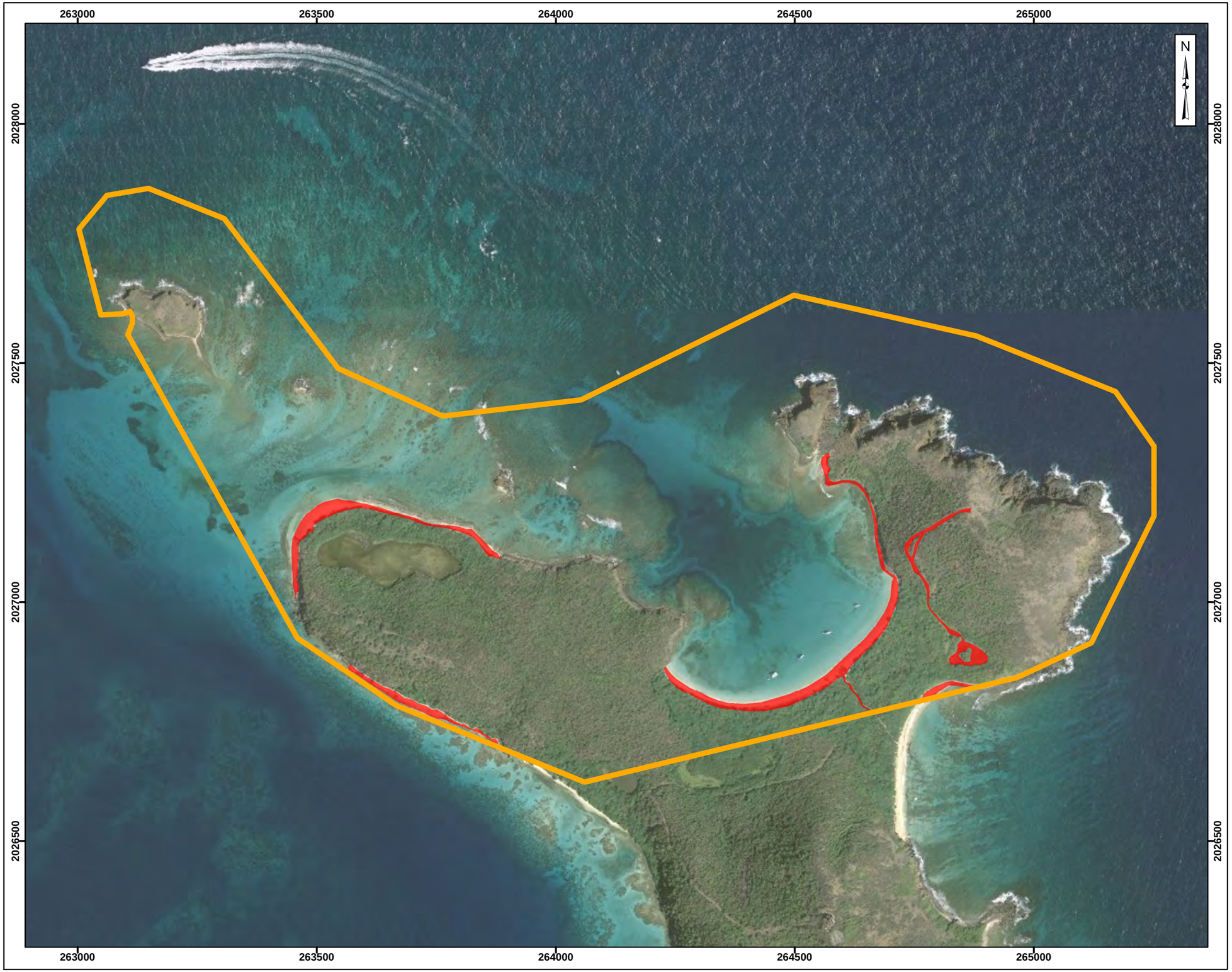
Figure 3
Location of Proposed MRS 07 Alternatives



Legend

- MRS 07 Boundary
- Surface/Subsurface Removal of MEC/MPPEH within frequented areas (i.e., beaches and trails)

0 200 400 Meters

Data Source: USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

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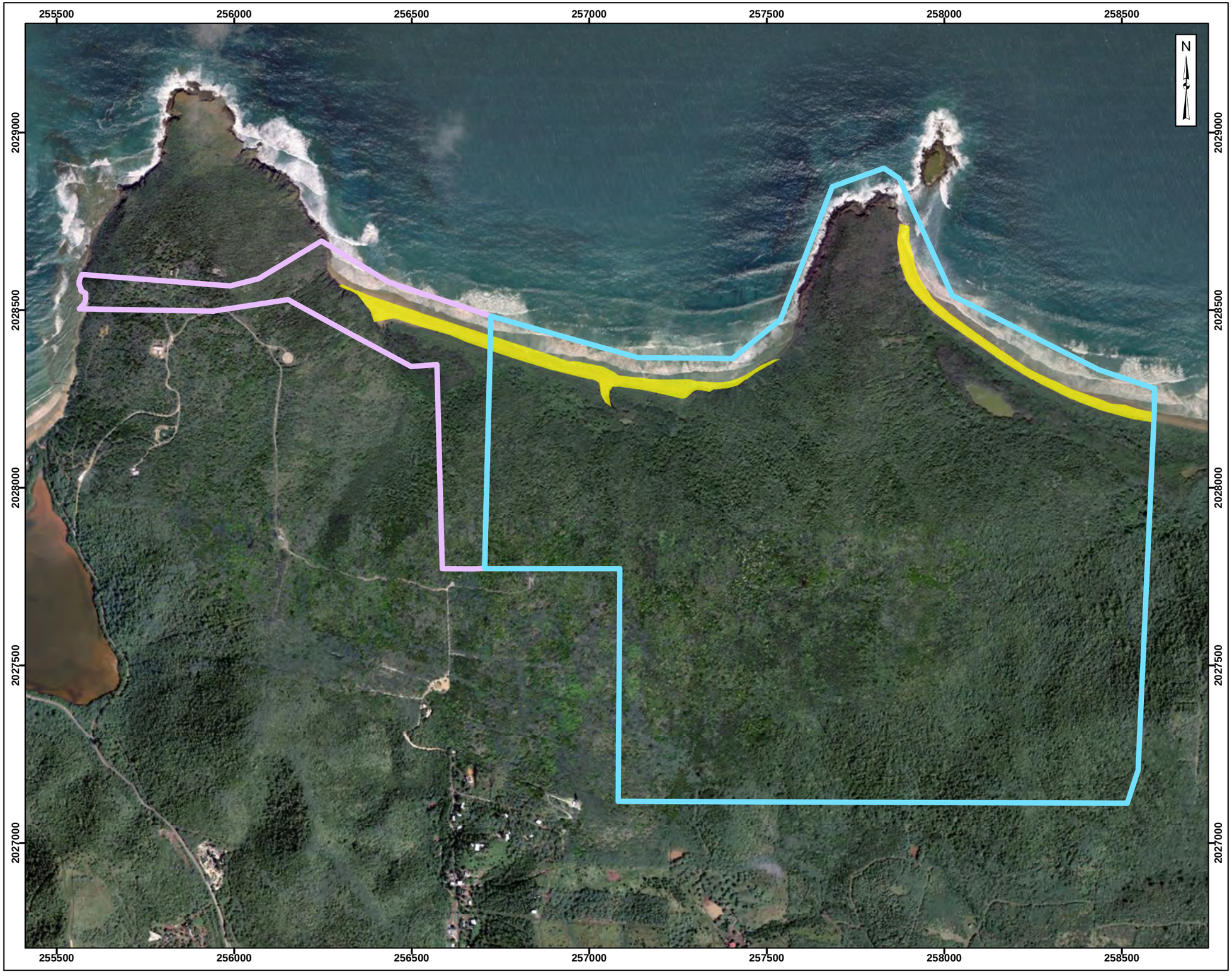
Figure 4
Location of Proposed U.S. Fish and Wildlife Area Alternatives



Legend

- MRS 04 - USFWA
- MRS 05 - USFWA
- Surface and/or Subsurface Removal of MEC/MPPEH within frequented areas (i.e., beaches and trails)

0 200 400 Meters

Data Source: USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

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Figure 5
Location of Proposed MRS 02 - Cayo Lobo and MRS 02 - Cayo Yerba Alternatives

Legend

- Surface/Subsurface Removal of MEC/MPPEH within frequented areas (i.e., beaches and trails)
- Surface and/or Subsurface Removal of MEC/MPPEH within frequented areas (i.e., beaches and trails)

0 200 400 Meters

Data Source: USA Prime Imagery, 2007

Coordinate System: UTM 20N
Datum: NAD83
Units: Meters

APPENDIX A: COST ESTIMATES

Table A-1
MRS02 - Inaccessible Cays
Limited Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$18,000	$18,000	$0	Engineering estimate for UXO technicians to conduct surface sweep on beaches only
3. Brush Cutting		1	LS	$0	$0	$0	Assume no vegetation on beaches
4. Demolition		1	LS	$6,500	$6,500	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$1,200	$1,200	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$45,700	$0	
SUBTOTAL (I and II)					$110,700	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate for maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$110,700	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$5,500	$5,500	$0	
2. Procurement	5% of Capital Costs	1	LS	$5,500	$5,500	$0	
3. Construction Management	12% of Capital Costs	1	LS	$13,300	$13,300	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$16,600	$16,600	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$60,900	$29,300	
SUBTOTAL (I, II, III, and IV)					$171,600	$224,800	

Table A-2
MRS02 - Inaccessible Cays
Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$298,000	$298,000	$0	Engineering estimate for UXO technicians to conduct surface sweep
3. Brush Cutting		1	LS	$105,000	$105,000	$0	Engineering estimate for vegetation removal
4. Demolition		1	LS	$18,500	$18,500	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$3,500	$3,500	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$445,000	$0	
SUBTOTAL (I and II)					$510,000	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$510,000	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$25,500	$25,500	$0	
2. Procurement	5% of Capital Costs	1	LS	$25,500	$25,500	$0	
3. Construction Management	12% of Capital Costs	1	LS	$61,200	$61,200	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$76,500	$76,500	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$208,700	$29,300	
SUBTOTAL (I, II, III, and IV)					$718,700	$224,800	
A. TOTAL CAPITAL COSTS					$719,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$944,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-3
MRS 02 - Cayo Lobo
Limited Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$50,000	$50,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$50,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface/Subsurface Removal		1	LS	$16,000	$16,000	$0	Engineering estimate for UXO technicians to conduct surface/subsurface removal using analog along beaches
3. Brush Cutting		1	LS	$0	$0	$0	No vegetation removal along beaches
4. Demolition		1	LS	$6,500	$6,500	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$1,200	$1,200	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$43,700	$0	
SUBTOTAL (I and II)					$93,700	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$3,000	$0	$90,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$105,500	
SUBTOTAL (I, II and III)					$93,700	$105,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$4,700	$4,700	$0	
2. Procurement	5% of Capital Costs	1	LS	$4,700	$4,700	$0	
3. Construction Management	12% of Capital Costs	1	LS	$11,200	$11,200	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$14,100	$14,100	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$15,800	$0	$15,800	
SUBTOTAL					$54,700	$15,800	
SUBTOTAL (I, II, III, and IV)					$148,400	$121,300	
A. TOTAL CAPITAL COSTS					$148,000		
B. TOTAL ANNUAL COSTS						$121,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$269,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-4
MRS02 - Cayo Yerba
Limited Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$50,000	$50,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$50,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$8,500	$8,500	$0	Engineering estimate for UXO technicians to conduct surface sweep
3. Brush Cutting		1	LS	$0	$0	$0	No vegetation removal on beaches
4. Demolition		1	LS	$6,500	$6,500	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$1,200	$1,200	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$36,200	$0	
SUBTOTAL (I and II)					$86,200	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$3,000	$0	$90,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$105,500	
SUBTOTAL (I, II and III)					$86,200	$105,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$4,300	$4,300	$0	
2. Procurement	5% of Capital Costs	1	LS	$4,300	$4,300	$0	
3. Construction Management	12% of Capital Costs	1	LS	$10,300	$10,300	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$12,900	$12,900	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$15,800	$0	$15,800	
SUBTOTAL					$51,800	$15,800	
SUBTOTAL (I, II, III, and IV)					$138,000	$121,300	
A. TOTAL CAPITAL COSTS					$138,000		
B. TOTAL ANNUAL COSTS						$121,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$259,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-5
MRS02 - Cayo Yerba
Limited Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$50,000	$50,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$50,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Brush Cutting		1	LS	$0	$0	$0	No vegetation removal on beaches
3. Mag and Dig		1	LS	$15,500	$15,500	$0	Engineering estimate to perform mag and dig
4. Demolition		1	LS	$6,500	$6,500	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$1,200	$1,200	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$43,200	$0	
SUBTOTAL (I and II)					$93,200	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$3,000	$0	$90,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$105,500	
SUBTOTAL (I, II and III)					$93,200	$105,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$4,700	$4,700	$0	
2. Procurement	5% of Capital Costs	1	LS	$4,700	$4,700	$0	
3. Construction Management	12% of Capital Costs	1	LS	$11,200	$11,200	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$14,000	$14,000	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$15,800	$0	$15,800	
SUBTOTAL					$54,600	$15,800	
SUBTOTAL (I, II, III, and IV)					$147,800	$121,300	
A. TOTAL CAPITAL COSTS					$148,000		
B. TOTAL ANNUAL COSTS						$121,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$269,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-6
MRS02 - Cerro Balcon
Limited Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$81,340	$81,340	$0	Engineering estimate for UXO technicians to conduct surface sweep
3. Brush Cutting		1	LS	$62,250	$62,250	$0	Engineering estimate for vegetation removal
4. Demolition		1	LS	$7,138	$7,138	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$1,245	$1,245	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$171,973	$0	
SUBTOTAL (I and II)					$236,973	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$236,973	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$11,800	$11,800	$0	
2. Procurement	5% of Capital Costs	1	LS	$11,800	$11,800	$0	
3. Construction Management	12% of Capital Costs	1	LS	$28,400	$28,400	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$35,500	$35,500	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$107,500	$29,300	
SUBTOTAL (I, II, III, and IV)					$344,473	$224,800	
A. TOTAL CAPITAL COSTS					$344,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$569,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-7
MRS02 - Cerro Balcon
Limited Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Brush Cutting		1	LS	$62,250	$62,250	$0	Engineering estimate for vegetation removal
3. Surface/Subsurface Removal		1	LS	$186,750	$186,750	$0	Engineering estimate to perform surface/subsurface removal using a combination of analog and DGM
4. Demolition		1	LS	$14,940	$14,940	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$4,150	$4,150	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$288,090	$0	
SUBTOTAL (I and II)					$353,090	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$353,090	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$17,700	$17,700	$0	
2. Procurement	5% of Capital Costs	1	LS	$17,700	$17,700	$0	
3. Construction Management	12% of Capital Costs	1	LS	$42,400	$42,400	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$53,000	$53,000	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$150,800	$29,300	
SUBTOTAL (I, II, III, and IV)					$503,890	$224,800	
A. TOTAL CAPITAL COSTS					$504,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$729,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-8
MRS04 - USFWS Area
Limited Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$10,560	$10,560	$0	Engineering estimate for UXO technicians to conduct surface sweep
3. Brush Cutting		1	LS	$0	$0	$0	No veg removal on beaches and trails
4. Demolition		1	LS	$1,870	$1,870	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$550	$550	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$32,980	$0	
SUBTOTAL (I and II)					$97,980	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$97,980	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$4,900	$4,900	$0	
2. Procurement	5% of Capital Costs	1	LS	$4,900	$4,900	$0	
3. Construction Management	12% of Capital Costs	1	LS	$11,800	$11,800	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$14,700	$14,700	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$56,300	$29,300	
SUBTOTAL (I, II, III, and IV)					$154,280	$224,800	
A. TOTAL CAPITAL COSTS					$154,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$379,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-9
MRS04 - USFWS Area
Limited Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface/Subsurface Removal		1	LS	$34,100	$34,100	$0	Engineering estimate for UXO technicians to conduct surface/subsurface removal using analog on beaches
3. Brush Cutting		1	LS	$0	$0	$0	No vegetation removal on beaches/trails
4. Demolition		1	LS	$3,520	$3,520	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$704	$704	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$58,324	$0	
SUBTOTAL (I and II)					$123,324	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$123,324	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$6,200	$6,200	$0	
2. Procurement	5% of Capital Costs	1	LS	$6,200	$6,200	$0	
3. Construction Management	12% of Capital Costs	1	LS	$14,800	$14,800	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$18,500	$18,500	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$65,700	$29,300	
SUBTOTAL (I, II, III, and IV)					$189,024	$224,800	
A. TOTAL CAPITAL COSTS					$189,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$414,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-10
MRS05 - USFWS Area
Limited Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$37,440	$37,440	$0	Engineering estimate for UXO technicians to conduct surface sweep
3. Brush Cutting		1	LS	$0	$0	$0	No veg removal on beaches and trails
4. Demolition		1	LS	$6,630	$6,630	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$1,950	$1,950	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$66,020	$0	
SUBTOTAL (I and II)					$131,020	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$131,020	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$6,600	$6,600	$0	
2. Procurement	5% of Capital Costs	1	LS	$6,600	$6,600	$0	
3. Construction Management	12% of Capital Costs	1	LS	$15,700	$15,700	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$19,700	$19,700	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$68,600	$29,300	
SUBTOTAL (I, II, III, and IV)					$199,620	$224,800	
A. TOTAL CAPITAL COSTS					$200,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$425,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-11
MRS05 - USFWS Area
Limited Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface/Subsurface Removal		1	LS	$120,900	$120,900	$0	Engineering estimate for UXO technicians to conduct surface/subsurface removal using analog on beaches
3. Brush Cutting		1	LS	$0	$0	$0	No vegetation removal on beaches/trails
4. Demolition		1	LS	$12,480	$12,480	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$2,496	$2,496	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$155,876	$0	
SUBTOTAL (I and II)					$220,876	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$220,876	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$11,000	$11,000	$0	
2. Procurement	5% of Capital Costs	1	LS	$11,000	$11,000	$0	
3. Construction Management	12% of Capital Costs	1	LS	$26,500	$26,500	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$33,100	$33,100	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$101,600	$29,300	
SUBTOTAL (I, II, III, and IV)					$322,476	$224,800	
A. TOTAL CAPITAL COSTS					$322,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$547,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-12
MRS07
Limited Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$65,000	$65,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$65,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface/Subsurface Removal		1	LS	$32,000	$32,000	$0	Engineering estimate for UXO technicians to conduct surface/subsurface removal using analog on beaches and DGM on trails
3. Brush Cutting		1	LS	$0	$0	$0	No vegetation removal on beaches/trails
4. Demolition		1	LS	$22,000	$22,000	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$4,500	$4,500	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$78,500	$0	
SUBTOTAL (I and II)					$143,500	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$6,000	$0	$180,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$195,500	
SUBTOTAL (I, II and III)					$143,500	$195,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$7,200	$7,200	$0	
2. Procurement	5% of Capital Costs	1	LS	$7,200	$7,200	$0	
3. Construction Management	12% of Capital Costs	1	LS	$17,200	$17,200	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$21,500	$21,500	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$29,300	$0	$29,300	
SUBTOTAL					$73,100	$29,300	
SUBTOTAL (I, II, III, and IV)					$216,600	$224,800	
A. TOTAL CAPITAL COSTS					$217,000		
B. TOTAL ANNUAL COSTS						$225,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$442,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-13
MRS04 (Remaining Lands)
Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$198,000	$198,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$198,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$378,000	$378,000	$0	Engineering estimate for UXO technicians to conduct surface sweep
3. Brush Cutting		1	LS	$131,040	$131,040	$0	Engineering estimate for vegetation removal
4. Demolition		1	LS	$9,450	$9,450	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$2,205	$2,205	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$540,695	$0	
SUBTOTAL (I and II)					$738,695	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$10,000	$0	$300,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$315,500	
SUBTOTAL (I, II and III)					$738,695	$315,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$36,900	$36,900	$0	
2. Procurement	5% of Capital Costs	1	LS	$36,900	$36,900	$0	
3. Construction Management	12% of Capital Costs	1	LS	$88,600	$88,600	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$110,800	$110,800	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$47,300	$0	$47,300	
SUBTOTAL					$293,200	$47,300	
SUBTOTAL (I, II, III, and IV)					$1,031,895	$362,800	
A. TOTAL CAPITAL COSTS					$1,032,000		
B. TOTAL ANNUAL COSTS						$363,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$1,395,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-14
MRS04 (Remaining Lands)
Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$198,000	$198,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$198,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Brush Cutting		1	LS	$163,800	$163,800	$0	Engineering estimate for vegetation removal
3.Surface/Subsurface Removal		1	LS	$577,500	$577,500	$0	Engineering estimate to perform a combination mag and dig and DGM
4. Demolition		1	LS	$14,490	$14,490	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$4,620	$4,620	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$780,410	$0	
SUBTOTAL (I and II)					$978,410	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$10,000	$0	$300,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$315,500	
SUBTOTAL (I, II and III)					$978,410	$315,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$48,900	$48,900	$0	
2. Procurement	5% of Capital Costs	1	LS	$48,900	$48,900	$0	
3. Construction Management	12% of Capital Costs	1	LS	$117,400	$117,400	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$146,800	$146,800	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$47,300	$0	$47,300	
SUBTOTAL					$382,000	$47,300	
SUBTOTAL (I, II, III, and IV)					$1,360,410	$362,800	
A. TOTAL CAPITAL COSTS					$1,360,000		
B. TOTAL ANNUAL COSTS						$363,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$1,723,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-15
MRS05 (Remaining Lands)
Surface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$325,000	$325,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$325,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Surface Sweep		1	LS	$1,608,000	$1,608,000	$0	Engineering estimate for UXO technicians to conduct surface sweep
3. Brush Cutting		1	LS	$422,400	$422,400	$0	Engineering estimate for vegetation removal
4. Demolition		1	LS	$38,400	$38,400	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$12,000	$12,000	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$2,100,800	$0	
SUBTOTAL (I and II)					$2,425,800	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$12,000	$0	$360,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$375,500	
SUBTOTAL (I, II and III)					$2,425,800	$375,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$121,300	$121,300	$0	
2. Procurement	5% of Capital Costs	1	LS	$121,300	$121,300	$0	
3. Construction Management	12% of Capital Costs	1	LS	$291,100	$291,100	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$363,900	$363,900	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$56,300	$0	$56,300	
SUBTOTAL					$917,600	$56,300	
SUBTOTAL (I, II, III, and IV)					$3,343,400	$431,800	
A. TOTAL CAPITAL COSTS					$3,343,000		
B. TOTAL ANNUAL COSTS						$432,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$3,775,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE

Table A-16
MRS05 (Remaining Lands)
Surface/Subsurface Removal and LUCs

ITEM		QUANTITY	UNITS	UNIT COST	CAPITAL COST	ANNUAL O&M COST	ASSUMPTIONS
I. ADMINISTRATIVE ACTIONS							
1. Land-Use Restrictions and Planning		1	LS	$325,000	$325,000	$0	Engineering estimate for signs and staff to implement LUCs to manage any intrusive activity that may occur at the site and to draft, submit, and finalize any remedial planning
SUBTOTAL					$325,000	$0	
II. GENERAL ACTIONS AND SITE PREPARATION							
1. Mobilization / Demobilization		1	LS	$20,000	$20,000	$0	Engineering estimate to mobilize equipment and personnel to and from the site
2. Brush Cutting		1	LS	$676,800	$676,800	$0	Engineering estimate for vegetation removal
3. Surface/Subsurface Removal		1	LS	$3,806,400	$3,806,400	$0	Engineering estimate to perform a combination mag and dig and DGM
4. Demolition		1	LS	$50,400	$50,400	$0	Engineering estimate for explosive demolition of MEC items using consolidated and BIP procedures
5. MPPEH/MD Handling		1	LS	$16,800	$16,800	$0	Engineering estimate for scraps recovered during clearance activities to be transferred to a centralized secure storage area for inpsection, demolition, and certification
SUBTOTAL					$4,570,400	$0	
SUBTOTAL (I and II)					$4,895,400	$0	
III. LONG-TERM MANAGEMENT, MONITORING & REVIEW							
1. Site Maintenance		30	Years	$12,000	$0	$360,000	Engineering estimate to maintain/replace signage
2. Five Year Review Reports		1	LS	$15,500	$0	$15,500	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Five Year Review Report
SUBTOTAL					$0	$375,500	
SUBTOTAL (I, II and III)					$4,895,400	$375,500	
IV. IMPLEMENTATION COSTS							
1. Administration and Legal	5% of Capital Costs	1	LS	$244,800	$244,800	$0	
2. Procurement	5% of Capital Costs	1	LS	$244,800	$244,800	$0	
3. Construction Management	12% of Capital Costs	1	LS	$587,400	$587,400	$0	
4. Completion Report		1	LS	$20,000	$20,000	$0	Engineering estimate to compile the Draft, Draft Final, and Final versions of the Completion Report
5. Cost Contingency	15% of Capital Costs	1	LS	$734,300	$734,300	$0	
6. O&M Contingency	15% of O&M Costs	1	LS	$56,300	$0	$56,300	
SUBTOTAL					$1,831,300	$56,300	
SUBTOTAL (I, II, III, and IV)					$6,726,700	$431,800	
A. TOTAL CAPITAL COSTS					$6,727,000		
B. TOTAL ANNUAL COSTS						$432,000	
TOTAL CAPITAL AND ANNUAL COSTS (A + B)						**$7,159,000**	

LS - Lump Sum
All construction assumed to be conducted in Level D PPE