FINAL

Environmental Baseline Survey Report

Underwater Portions of MRSs 07 and 02

Culebra, Puerto Rico

FUDS Project No: I02PR0068

Contract: W912DY-09-D-0062
Task Order: 0010

Prepared For:
U.S. Army Corps of Engineers
Jacksonville District
701 San Marco Boulevard
Jacksonville, Florida 32207
and
U.S. Army Engineering & Support Center, Huntsville
4820 University Square
Huntsville, Alabama 35816-1822

Prepared By:

PARSONS

3577 Parkway Lane, Suite 100
Norcross, Georgia 30092

March 2014

Environmental Baseline Survey Report

Underwater Portions of MRSs 07 and 02
Culebra, Puerto Rico

prepared for:

U.S. ARMY CORPS OF ENGINEERS, JACKSONVILLE DISTRICT
and
U.S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE

Contract No. W912DY-09-D-0062
Task Order No. 0010
FUDS Project No. I02PR0068

prepared by:

PARSONS

March 2014

Revision: 0

Jae Yun
QC Reviewer: _____ (Signature) 03-26-2014 (Date)

Patti Berry
Project Manager: _____ (Signature) 03-26-2014 (Date)

The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation.

TABLE OF CONTENTS

CHAPTER 1. INTRODUCTION 1-1

1.1 PROJECT AUTHORIZATION 1-1
1.2 PURPOSE AND SCOPE OF THE EBS 1-1
1.3 REPORT ORGANIZATION 1-1
1.4 PROJECT LOCATION 1-2
1.5 SITE DESCRIPTION 1-2
1.5.1 Location 1-2
1.5.2 Topography 1-2
1.5.3 Climate 1-3
1.6 PROJECT ORGANIZATION 1-4
1.6.1 Project Stakeholders 1-4
1.6.1.1 USACE, Jacksonville District 1-5
1.6.1.2 USAESCH 1-5
1.6.1.3 Parsons 1-5
1.6.1.4 USA 1-5
1.6.1.5 Aqua Survey Inc. 1-5

CHAPTER 2. ENVIRONMENTAL BASELINE SURVEY APPROACH 2-1

2.1 EBS TECHNICAL APPROACH SUMMARY 2-1
2.1.1 Phase 1A: Hydrographic Surveys 2-1
2.1.2 Phase 1B: Underwater Visual Surveys 2-1
2.1.3 EBS Data Quality Objectives 2-2
2.1.3.1 Preliminary Project Goals (EBS) 2-2
2.1.3.2 Data Quality Objectives 2-2
2.1.4 EBS Work Plan 2-4
2.2 SUMMARY OF FIELDWORK 2-4
2.2.1 Phase 1A Data Collection Activities 2-4
2.2.1.1 Multibeam Bathymetry Survey (MBS) 2-5
2.2.1.2 Side Scan Sonar (SSS) Survey 2-6
2.2.1.3 Revised RI Transect Design 2-7
2.2.2 Phase 1B Data Collection Activities 2-8
2.2.2.1 Underwater Video Transect Surveys 2-8
2.2.2.2 Snorkeling Transects 2-8
2.2.2.3 VideoRay Surveys 2-9
2.2.3 QC Inspections/Audits 2-9

CHAPTER 3. EBS RESULTS 3-1

3.1 ENDANGERED SPECIES ACT AND NATIONAL WILDLIFE REFUGE BACKGROUND INFORMATION 3-1
3.2 OBSERVED BENTHIC HABITAT TYPES 3-2
3.2.1 Description of Observed Benthic Habitats in MRSs 07 and 02 3-2
3.2.2 Unconsolidated Sediments/Submerged Vegetation 3-2

3.2.3 Colonized or Uncolonized Hard Bottom and Coral Reef 3-2
3.3 PRESENCE OF ESSENTIAL FISH HABITATS 3-3
3.4 PRESENCE OF THREATENED AND ENDANGERED SPECIES 3-3
3.4.1 Federally Listed Species Potentially Present 3-3
3.4.1.1 Endangered Species (Descriptions in the EBS WP): 3-3
3.4.1.2 Threatened Species (Descriptions in the EBS WP) 3-3
3.4.2 Critical Habitat 3-4
3.4.3 Threatened or Endangered Species Observed 3-4
3.5 DETAILED FINDINGS WITHIN EACH MRS 3-5
3.5.1 MRS 02 3-5
3.5.1.1 Cayo Lobito 3-5
3.5.1.2 Cayo Lobo 3-6
3.5.1.3 El Mono 3-6
3.5.1.4 Cayo Yerba 3-6
3.5.1.5 Cayo Raton 3-6
3.5.1.6 Cayo del Agua 3-7
3.5.1.7 Piedra Stevens 3-7
3.5.1.8 Los Gemelos 3-7
3.5.1.9 Alcarraza 3-7
3.5.1.10 Sombrerito 3-7
3.5.1.11 Cayo Tiburon 3-8
3.5.1.12 Cayos Geniqui 3-8
3.5.2 MRS 07 - Culebrita 3-8
3.6 DIFFICULTIES ENCOUNTERED AND LESSONS LEARNED 3-9
3.6.1 Weather 3-9
3.6.2 Topography 3-9
3.6.3 Currents 3-9
3.6.4 Transect Orientation 3-10
CHAPTER 4. PHASE 2 TRANSECT DESIGN 4-1
4.1 PHASE 2: UNDERWATER GEOPHYSICAL TRANSECT SURVEYS 4-1
4.1.1 EM Platform Selection Process 4-1
4.2 PHASE 3: INTRUSIVE INVESTIGATIONS AND ENVIRONMENTAL SAMPLING 4-2
4.2.1 Underwater Intrusive Investigations 4-2
4.2.2 Environmental Sampling 4-2
4.3 SUMMARY 4-2
CHAPTER 5. REFERENCES 5-1
5.1 U.S. ARMY CORPS OF ENGINEERS GUIDANCE DOCUMENTS 5-1
5.2 U.S. ARMY DOCUMENTS 5-1
5.3 DEPARTMENT OF DEFENSE DOCUMENTS 5-1
5.4 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION 5-1
5.5 U.S. ENVIRONMENTAL PROTECTION AGENCY 5-2
5.6 FEDERAL REGULATION 5-2
5.7 COMMONWEALTH OF PUERTO RICO REGULATIONS 5-2
5.8 OTHER DOCUMENTATION/SURVEYS AND STUDIES FOR THE EBS REPORT 5-2

LIST OF APPENDICES

Appendix A Maps
Appendix B Photographs
Appendix C Hydrographic Data & GIS Files (DVD)
Appendix D Transect Video Files (DVD)
Appendix E Daily Reports/ Quality Control Reports / Safety Reports / Observation Forms

LIST OF FIGURES

Figure 1-1: Regional Location Map – MRSs 2 and 7 1-3

Figure 1-2: Project Organization 1-4

Figure 2-1: Example RI Transect Re-alignment 2-8

LIST OF TABLES

Table 1-1: EBS Report Structure 1-2

Table 1-2: Average Rainfall, Culebra Island 1-3

Table 2-1: EBS DQOs 2-2

Table 2-2: Biological Spot Investigations (ROV) 2-11

Table 3-1: Sea Turtle Sighting Summary Table 3-6

This space is intentionally left blank.

ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
ASI	Aqua Survey Inc.
CFR	Code of Federal Regulation
CH	Critical Habitat
DGPS	Differential GPS
DNER	Department of Natural and Environmental Resources
DA	Department of the Army
DGM	Digital Geophysical Mapping
DoD	Department of Defense
DQO	Data Quality Objective
DVD	Digital Versatile Disc
EBS	Environmental Baseline Survey
EFH	Essential Fish Habitat
EOD	Explosive Ordnance Disposal
EM	Electromagnetic
EQB	Environmental Quality Board
ESA	Endangered Species Act
ft	foot (feet)
FUDS	Formerly Used Defense Site
GIS	Geographical Information System
GPS	Global Positioning System
HA	Hazard Assessment
IAW	In Accordance With
IHO	International Hydrographic Organization
MBS	Multibeam Bathymetry Survey
MC	Munitions Constituents
MEC	Munitions and Explosives of Concern
MPPEH	Material Potentially Presenting an Explosive Hazard
MRS	Munitions Response Site
MRU	Motion Reference Unit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWR	National Wildlife Refuge
OSHA	Occupational Safety and Health Administration
PDA	Personal Digital Assistant
PDT	Project Delivery Team
PR	Puerto Rico
PWS	Performance Work Statement
QA	Quality Assurance
QC	Quality Control
RI/FS	Remedial Investigation/Feasibility Study

ROV	Remotely Operated Vehicle
RTK-DGPS	Real-Time Kinematic Differential GPS
SLRA	Screening Level Risk Assessment
SOP	Standard Operating Procedure
SP	Snorkeling Plan
SSS	Side Scan Sonar
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USA	USA Environmental, Incorporated
USBL	Ultra-Short Baseline
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
U/W	Underwater
UXO	Unexploded Ordnance
VSP	Visual Sampling Plan
WP	Work Plan

This space is intentionally left blank.

CHAPTER 1. INTRODUCTION

1.1 PROJECT AUTHORIZATION

The United States Army Engineering and Support Center, Huntsville (USAESCH) contracted with Parsons Government Services Inc. (Parsons) to conduct an Environmental Baseline Survey (EBS) for the underwater (U/W) portions of munitions response sites (MRS) 07 and 02. Parsons has completed the required data collection activities for this project task in accordance with (IAW) the 10 February 2012 Performance Work Statement (PWS), Amendment of Solicitation/Modification of Contract No. W912DY-09-D-0062-0010, dated 25 July 2012, and the Work Plan (WP) Approval and Notice to Proceed letter received by email on May 30, 2013.

1.2 PURPOSE AND SCOPE OF THE EBS

The primary purpose and scope of the EBS was to perform an in-depth study designed to gather the data necessary to determine the U/W habitat within the Culebra Island MRSs 07 and 02 (water areas) for a Remedial Investigation/Feasibility Study (RI/FS). The intent of this EBS was not to perform an in-depth biological study; rather, it was to document the actual area where the RI activities will take place. The EBS is the first of three (3) phases of the RI/FS being conducted within the U/W portions of MRSs 07 and 02. The overall objective of the RI/FS is to determine the nature and extent of any contamination related to munitions and explosives of concern (MEC) and/or munitions constituents (MC) within the U/W portions of these MRSs. The results of the EBS, as presented in this report, will be used for decision making purposes during the subsequent Technical Planning Process (TPP) meetings for Phases 2 and 3, the U/W geophysical surveys, and intrusive investigations/environmental sampling, respectively. In addition, this report includes any data related to material potentially presenting an explosive hazard (MPPEH) that was observed during EBS field activities. MPPEH data will be included in the overall RI evaluation and associated MEC Hazard Assessment (MEC HA).

This report details the results of the following EBS field activities that were conducted:

- Phase 1A: Hydrographic Surveys (Deployment of Multi-beam Bathymetry and Side Scan Sonar systems); Fieldwork completed in June 2013
- Phase 1B: U/W Visual Surveys (U/W Video/still camera systems and snorkeling); Fieldwork completed in August 2013

All activities involving work in areas potentially containing MEC hazards were conducted in full compliance with USAESCH, U.S. Army Corps of Engineers (USACE), Department of the Army (DA), and Department of Defense (DoD) requirements regarding personnel, equipment, and procedures, and with Occupational Safety and Health Administration (OSHA) Standard 29 Code of Federal Regulation (CFR) Part 1910. In addition, field personnel adhered to the established Standard Operating Procedures (SOP)s developed for endangered species avoidance/mitigation (Appendix M of the final WP). These SOPs were reviewed on a daily basis to ensure compliance with the requirements.

1.3 REPORT ORGANIZATION

This EBS Report has been divided into Chapters 1 through 5, with associated documents provided as appendices herein, as standalone documents, or on Digital Versatile Discs (DVDs). Together, the report and associated documents present the project history, work elements, and EBS results in an organized manner. Table 1-1 describes the general structure and organization of this report. References are frequently made between various sections in the WP and the associated documents.

Table 1-1: EBS Report Structure

Chapter Number	Descriptor	Information
1	Introduction	A statement of the project objectives, project authorization, purpose and scope; summary of WP organization, project location, site descriptions, and project organization.
2	EBS Approach	Describes the EBS approach, related Data Quality Objectives (DQOs), and a summary of the data collection activities.
3	EBS Results	Provides details related to the EBS results, including discussions related to the delineated benthic habitats, the observed species and essential fish habitats within them. Included is identification of federally listed species present within the water portions of the MRSs.
4	Proposed RI Actions	Provides details related to the field activities anticipated for Phase 2 (U/W geophysical surveys) and Phase 3 (intrusive investigations/ environmental sampling) and their potential adverse effects on the observed benthic habitats. Provides recommended RI field activity implementation measures, including selection of appropriate equipment and mitigation measures and procedures related to data collection activities.
5	References	Provides references applicable to the overall RI/FS project and EBS Report.

The following appendices are included in this Report:

Appendix A Maps

Appendix B Photographs

Appendix C Hydrographic Data and Geographical Information System (GIS) files (DVD)

Appendix D Transect Video Files (DVD)

Appendix E Daily Reports/Quality Control Reports/Safety Reports/Observation Forms

1.4 PROJECT LOCATION

The project location is Culebra Island, PR, MRS 07 (Cayo Culebrita) and MRS 02 (surrounding cayos: Cayo Lobo, Cayo Lobito, El Mono, Cayo Del Agua, Cayo Yerba, Cayo Raton, Cayo Alcarraza, Cayo Los Gemelos, Cayo Piedra Stevens, Cayo Tiburon, Cayos Geniqui, and Cayo Sombrerito), all located approximately three-quarter miles off the northern, western, and eastern coasts of Culebra Island. MRS 07 covers the northern portion of Cayo Culebrita. However, this project includes investigation of the U/W areas surrounding the southwestern and southern boundaries of Cayo Culebrita.

1.5 SITE DESCRIPTION

1.5.1 Location

Site location is described in Subsection 1.4 and shown in Figure 1-1.

1.5.2 Topography

The Culebran Islands are underlain by both intrusive and extrusive volcanic rock of Upper Cretaceous age. The volcanic rock exhibits little or no porosity because of compaction and filling of the pores with quartz and calcite. Cayo Culebrita (MRS 07) is comprised of sandy beaches, irregular rugged coastlines and steep hills. Most of the MRS 02 cayos are smaller islands comprised of solid volcanic rock.

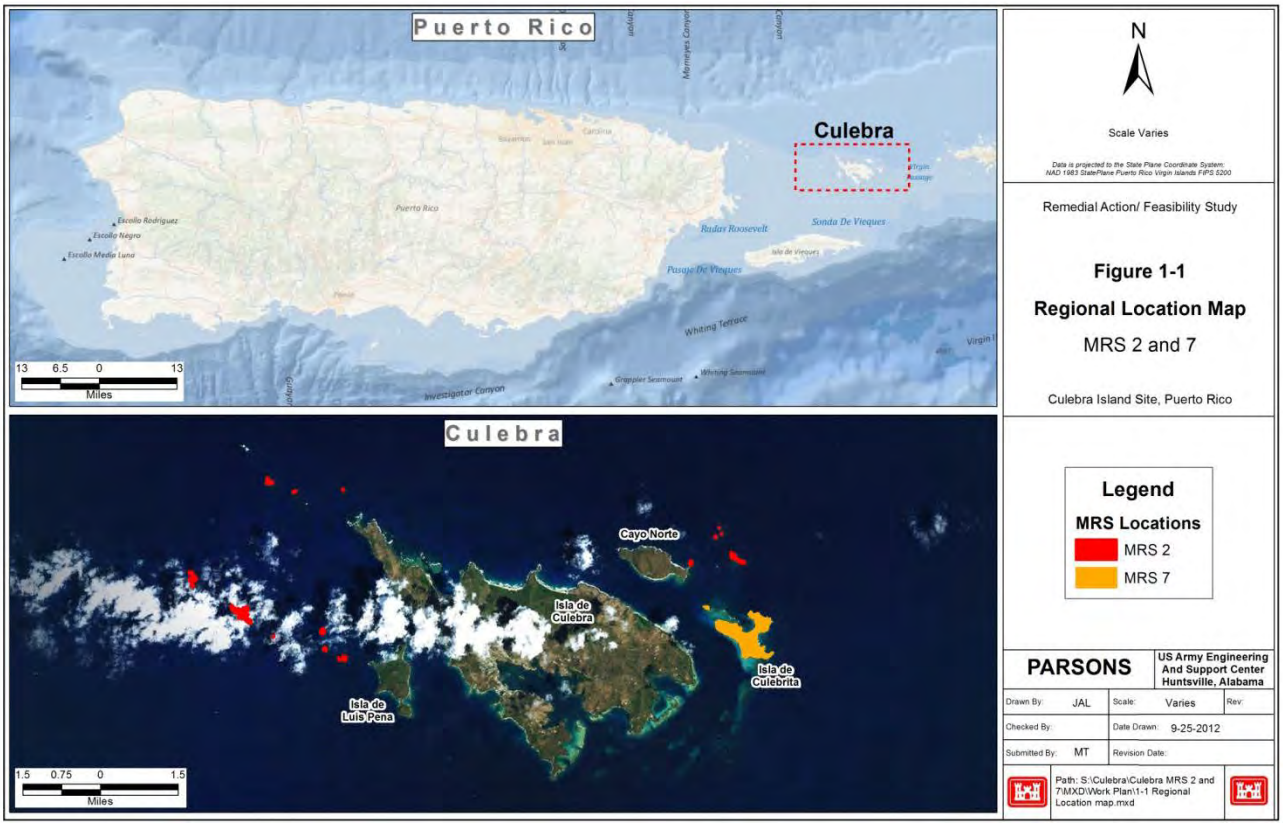

Figure 1-1: Regional Location Map – MRSs 2 and 7

1.5.3 Climate

The weather on Culebra Island is generally warm year round due to its tropical marine climate. Yearly average rainfall is approximately 36 inches. The months of August through November are considered the wet season, and the driest months are January through April. The average daily temperature is 80 degrees Fahrenheit (°F) year round with an average daily maximum of 86°F and an average low of 74°F. Winds are generally from the east-northeast during November through January and from the east during February through October. Yearly average wind speed is 8 knots. Hurricane season is from June through November, and severe hurricanes hit Culebra every 10 to 20 years. The yearly average rainfall for Culebra is provided in Table 1-2 (source: www.weather.com).

Table 1-2: Average Rainfall, Culebra Island

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
inches	2.38	1.48	1.42	2.74	3.06	2.53	2.85	3.74	5.58	5.42	5.23	2.96	39.39

Phase 1A fieldwork was executed during the month of June, 2013. Sea state was often the limiting factor for marine operations. The combination of wave swells and waves generated by winds created weather delays and extended the fieldwork by several days. Winds averaged 15-20 knots, creating small craft warnings throughout the duration of the project. Phase 1B fieldwork was executed during the month of August, 2013. The winds averaged 15 knots, with one field day requiring operations to be cancelled due to high winds and high seas. To take full advantage of the conditions presented, the field teams worked

on the lee of the islands when the sea state was high, and when the sea state was light or moderate the field teams concentrated their efforts on the windward side of the MRSs.

1.6 PROJECT ORGANIZATION

For this project to be successful, close coordination and cooperation between the stakeholders, community, regulators, and technical support personnel was necessary during the development of the EBS WP. Figure 1-2 depicts the organizational structure of the Parsons/USA Environmental, Inc. (USA) project team with respect to the USACE. Other team members included the Culebra site stakeholders/TPP members. The roles of the primary team members are described below.

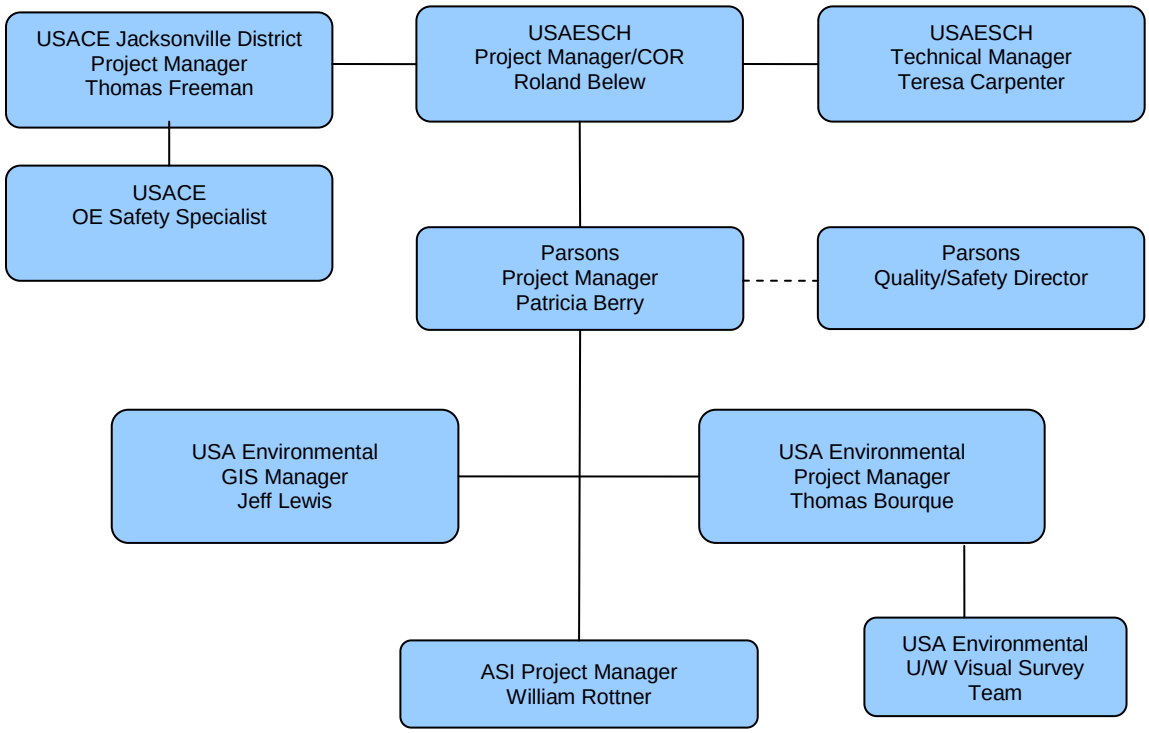

Figure 1-2: Project Organization

1.6.1 Project Stakeholders

The project stakeholders are those individuals and organizations directly impacted by the survey activities and the utilization of the resulting EBS Report data. Stakeholders include (but are not limited to):

- Puerto Rico Department of Natural and Environmental Resources (PR DNER)
- Puerto Rico Environmental Quality Board (PR EQB)
- United States Environmental Protection Agency (USEPA)
- Culebra National Wildlife Refuge
- US Fish and Wildlife Service (USFWS)
- National Oceanic and Atmospheric Administration (NOAA)
- National Marine Fisheries Service (NMFS)

The stakeholders listed above participated in the TPP process for Culebra's Formerly Used Defense Sites (FUDS) projects.

1.6.1.1 USACE, Jacksonville District

USACE Jacksonville District is the project management and funding agency for this project. Responsibilities of the USACE Jacksonville District, in addition to overall project management, include review of project plans and documents, coordination with the news media and the public, and coordination with national, state, and local regulatory agencies on issues pertaining to protection of ecological and cultural resources.

1.6.1.2 USAESCH

USAESCH is the lead technical agency for this project. Responsibilities of USAESCH include procurement of contract services, review and coordination of project plans and documents, and supporting USACE Jacksonville District in working with the news media, the public, and the regulators. USAESCH provides technical expertise for MEC activities. As the Technical Project Manager, USAESCH is responsible for controlling the budget and schedule. As the contracting agency, USAESCH is responsible for directing the contractor.

1.6.1.3 Parsons

Parsons is the prime contractor to USAESCH for this project. Parsons provides staff to perform the Field Management for Phases 1A and 1B, and provides project oversight. Parsons subcontracts to USA, with Aqua Survey Inc. (ASI) as a tiered subcontractor under USA to conduct hydrographic surveys.

1.6.1.4 USA

USA provides the field teams in support of U/W RI activities. USA provided snorkeling teams and the remote operating vehicle (ROV) with operators for Phases 1A and 1B.

1.6.1.5 Aqua Survey Inc.

ASI is USA's hydrographic subcontractor for this project. ASI provided field personnel, a survey vessel, and equipment to perform all hydrographic surveys, to include side scan sonar (SSS) and multi-beam bathymetry surveys (MBS) for Phase 1A. ASI also provided a marine scientist for the visual surveys in Phase 1B. ASI conducted all work under Parsons' oversight.

This space is intentionally left blank.

This page is intentionally left blank.

CHAPTER 2. ENVIRONMENTAL BASELINE SURVEY APPROACH

2.1 EBS TECHNICAL APPROACH SUMMARY

The overall objective of the RI is to determine the nature and extent of MEC and MC within the U/W portions surrounding MRSs 07and 02. During project development, it was determined by USACE that an initial effort would be required to establish the baseline environmental conditions of the investigation areas (U/W portions of MRS 07and 02) given the sensitive environments (benthic habitats) that were present. These benthic habitats contain species that are sensitive to anthropogenic activities and could be impacted by RI data collection activities, i.e., conducting geophysical and intrusive investigations. To address this, Parsons/USA developed a two-stage approach (Phase 1A and Phase 1B) for collecting data necessary to delineate the benthic habitats present within the RI areas, with the goal of utilizing the data to plan subsequent RI fieldwork.

2.1.1 Phase 1A: Hydrographic Surveys

Phase 1A, the initial data collection stage, consisted of conducting hydrographic surveys (SSS and MBS) IAW the DQOs. After hydrographic data was collected, an analysis was performed to compare the location of the initial idealized RI transects (U/W geophysical survey lines) against the benthic terrain (i.e., coral structures and sand beds) detailed by the SSS and MBS data (Appendix C). Analysis of the hydrographic data was essential for selecting an appropriate platform for deploying geophysical equipment along the RI transects close to or on the sea floor surface.

The hydrographic data analysis included a review and comparison of benthic features previously delineated by the NOAA in a report titled *Methods Used to Map the Benthic Habitats of Puerto Rico and the U.S. Virgin Islands* (Kendall, M.S., et al. 2001*).* This Report, which is contained in Appendix Q of the EBS WP, provides the detailed methodology for delineation of benthic habitats using aerial photography and GIS to map the various benthic features within Puerto Rico and the U.S. Virgin Islands. Parsons/USA was able to modify the benthic GIS files (shape files) based on the hydrographic data collected. This refinement was necessary given the wide area assessment nature of the NOAA data. As a result of this analysis, Parsons/USA revised the idealized RI transect positioning/alignment based on avoiding significant benthic features proud above the seafloor (e.g., significant coral structures, boulders, or large debris). The revised RI transects are shown in the maps provided in Appendix A of this report.

2.1.2 Phase 1B: Underwater Visual Surveys

In order to ground truth both the hydrographic data (Phase 1A) and the NOAA benthic GIS data, Parsons/USA conducted Phase 1B, which consisted of deploying vessel-based U/W camera systems along the re-aligned RI transects to collect video footage. Given that the objective of the EBS is to document the benthic habitat where RI activities will occur, video was collected only along the re-aligned transects and in select areas of interest (MPPEH items). The intent of this stage of Phase 1 was not to perform an in-depth biological study; rather, it was to document the actual area where the RI activities will take place.

Video footage was reviewed and correlated with the hydrographic data and the NOAA refined benthic GIS data. In addition, Parsons/USA utilized a ROV to perform “spot” investigations of various benthic features, including representative species that populate the benthic habitats within MRSs 07 and 02. This information was captured on video (Appendix D). Parsons/USA also collected ROV video footage of MPPEH items that were observed along the video transect surveys. This data will be saved for later use in the RI.

2.1.3 EBS Data Quality Objectives

2.1.3.1 Preliminary Project Goals (EBS)

The preliminary project goal of the EBS was to document, in the form of this report, the various U/W benthic habitats that are present within the water portions of MRSs 07 and 02 in order to establish the parameters for conducting the subsequent RI field activities (U/W geophysical surveys and intrusive investigations/environmental sampling) within MRSs 07 and 02. Based on this preliminary project goal, site characterization goals were as stated in Step 2 of the DQO process in Table 2-1.

2.1.3.2 Data Quality Objectives

DQOs are qualitative and quantitative statements that clarify project objectives, define the appropriate type of data, and specify the tolerable levels of potential decision errors that are used as the basis for establishing the quality and quantity of data needed to support decisions. These project specific statements describe the intended data use; the data need requirements and the means to achieve acceptable data quality for the intended use. DQOs established for the EBS activities met the USEPA QA/G-4HW Guidance's 7 step DQO criteria. The DQOs developed for the EBS WP are presented in Table 2-1.

Table 2-1: EBS DQOs

DQO STEPS	Water Acreage of MRS 07 and MRS 02
1. State Problem	The overarching problem is determining the nature and extent of MEC/MC within the accessible areas[1] of the U/W portions of MRSs 07 and 02 while minimizing disturbance to endangered and threatened species and sensitive U/W environments within the investigation footprint. An initial Baseline Survey effort (Phase 1) will be required in order to establish the parameters for conducting subsequent RI/FS field activities (U/W Electromagnetic (EM) Surveys and Intrusive Investigations) within MRSs 07 and 02.
2. Identify the Goal of the Study	• Document the bathymetry within the water portions of the MRSs. • Document and verify the types of benthic habitats that are located within the proposed MEC and MC investigation areas of each MRS. • Identify and locate (map) coral, sea grass, sandy areas, essential fish habitats, and endangered and threatened species within the U/W portions of the MRSs. • Investigate and document suspected MEC items that may be located on the surface of the sea floor within the MRSs. • Develop a minimum mapping unit (area) to be mapped as habitat such that the data can be used with existing maps; and • Establish an RI transect design for conducting subsequent U/W geophysical surveys and intrusive investigations that considers the locations of sensitive habitat and endangered and threatened species.
3. Identify Information Inputs	• Collection of MBS and SSS data [International Hydrographic Organization (IHO) Order I Hydrographic Survey]; • Collection and analysis of U/W visual survey data (U/W camera systems deployed by vessels or snorkelers with integrating positioning using Global Positioning System (GPS)); • Analysis of documented Puerto Rico/Caribbean benthic habitats and listed endangered/threatened species, and corals proposed for listing as

DQO STEPS	Water Acreage of MRS 07 and MRS 02
	threatened or endangered and their locations within the investigation footprints; • Locations of suspected surface MEC items within accessible water areas of the MRS boundary.
4. Define the Boundaries of the Study	The MRS boundary defines the population to be sampled and the decision units to which the data will be applied. Step-out visual investigations may be required to modify/expand MRS boundary in areas where MEC has been identified on the sea floor. The population for this project consists of the U/W (benthic) areas of MRSs 07 and 02. The boundary may be reconfigured to relocate inaccessible[1] acreage to investigate the U/W areas of eastern Culebrita.
5. Develop a Decision Rule	Data gathering requirements for completing a EBS Report will be considered met after the following items have been achieved: • A hydrographic survey within the accessible[1] water areas MRSs 07 and 02 is completed. Hydrographic surveys will be conducted from a vessel in waters no less than 4-ft depth (measured to limit of depth accessed by an ROV, U/W Camera, SSS, or MBS equipment). No vessel surveys will be conducted in areas where corals are observed within 3 ft of the water's surface. • Depths less than 4 ft will be surveyed by a snorkeling team but no snorkel surveys will be conducted in areas where corals are within 2 ft of the water's surface. • Hydrographic survey data meeting the IHO standards noted in Table 3-2 in the EBS WP are sufficient to plan follow-on Phase 2 and Phase 3 investigations. • The benthic habitats and endangered/threatened species within the accessible[1] U/W areas of MRSs 07 and 02 have been mapped. The anticipated survey areas are established along idealized transects in the approved EBS WP. • Step-out visual investigations within the MRS boundary will be conducted in a 100-ft (horizontal) radius around MEC items located along the idealized visual transects (spaced at 250 ft). If additional MEC are located within the first step-out, an additional 100-ft radius will be visually investigated. Step-outs will stop when crossing overlapping step-out areas, or if no additional MEC are located within a 100-ft radius. • For MEC items located within 100 horizontal feet from the MRS boundary, the initial step-out will be 100 ft, the second 100 ft (if required), and the Project Delivery Team (PDT) will be consulted if additional step outs are needed. • If access is restricted by coral reefs or other features exposed to the water surface that do not allow for survey activities to be safely conducted, the PDT will be consulted.
6. Specify Performance or Acceptance Criteria	• Measurable decision errors are limited to the field and analytical Quality Control (QC) processes identified in the EBS WP for survey coverage. Work will be performed in accordance with established SOPs for U/W surveys.

DQO STEPS	Water Acreage of MRS 07 and MRS 02
	• Acceptable survey data for hydrographic surveys will be coverage of all accessible areas of the water portions of each MRS. • The completed hydrographic survey meets IHO Order I parameters as defined in the EBS WP and meets the quality standards outlined in the QC Plan (Chapter 4 of the EBS WP). • Acceptable U/W visual survey coverage will be stationed on idealized geophysical transects spaced at 167.32-ft (RI design) for subsequent EM-61 deployment (Phase 2) based on the hydrographic survey data. Visual Sampling Plan (VSP) parameters are based on expected target size and munition type. Width of visual coverage (corridor along transects) will vary depending on conditions.
7. Develop the Detailed Plan for Obtaining Data	Data collection procedures and associated QC measurements are included in the EBS WP. A combination of VSP and visual analysis of accessible[1] areas within the investigation footprints were used to develop the transect design reflected in the EBS WP. Hydrographic data collected during Phase 1A will be utilized to refine the transect locations for the visual survey conducted in Phase 1B.

Footnotes:
[1] *For the purposes of this DQO: "accessible" means:*

- *For Vessels: That access to the water portions of the MRS is <u>not</u> hindered by water depth, shallow rock or coral formations, or unsafe sea state conditions (consistently rough seas).*
- For Snorkeling Personnel: *That access to the water portions of the MRS is <u>not</u> hindered by unsafe sea state conditions (consistently rough seas). No snorkel surveys will be conducted in areas where corals are within 2 ft of the water's surface.*

2.1.4 EBS Work Plan

The final EBS WP was approved on 30 May 2013 and incorporates all of the approved field activities necessary to collect data to satisfy the EBS DQOs (Table 2-1 above, WP Table 3-1). References in this report are frequently made to the WP and/or its appendices.

2.2 SUMMARY OF FIELDWORK

2.2.1 Phase 1A Data Collection Activities

Although the basis of the RI technical approach is to conduct geophysical surveys along idealized survey transects (1 meter wide), the Phase 1A EBS data collection activities (hydrographic surveys) were conducted in all of the accessible areas of each MRS, as defined by the DQOs. Figures A-1 through A-5 in Appendix A show the Phase 1A coverage areas with the initial idealized RI transects. Given the nature of the benthic setting within the accessible areas of the MRS, various survey spacings were utilized to ensure the hydrographic survey coverage required by the DQOs. Survey lines were planned with 40 meter spacing at MRS 2 and 50 meter spacing at MRS 07, and were planned roughly parallel to the shoreline.

Prior to initiating work, all personnel received training and briefings regarding the importance of Listed Threatened and Endangered species, their characteristics, how they could be identified, potential and critical habitats, types of habitat in which they reside, actions to take if they were sighted, and avoidance measures to be followed as detailed in the USACE SOP, *Endangered Species and Conservation and Their Critical Habitat During Underwater Investigations at DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico*. This training was prepared and given by a marine biologist, trained to observe sea

turtles and marine mammals. The training also included safety and emergency procedures. During survey operations, endangered and threatened species were encountered. See Section 3.4.3 for details on species observed.

2.2.1.1 Multibeam Bathymetry Survey (MBS)

2.2.1.1.1 Instrumentation

ASI's MBS and positioning system were comprised of the following items:

- A Sea SWATHplus 488kHz high-resolution Interferometric bathymetric sonar was used to acquire the sounding data.
- Positioning data was supplied by a Trimble SPS 855 (Base), SPS 855 (Rover), GNSS GPS Real Time Kinematic (RTK) positioning system.
- Heading data came from a Hemisphere Crescent VS110 GPS heading device with antennas mounted 2 meters apart.
- Vessel motion was tracked and recorded from a SMC IMU-108 motion reference unit (MRU).
- Sound velocity data came from a Valeport Sound Velocity Mini SVS and Profiler Mini SVP.
- For surveying in areas which did not have a direct line of sight to the RTK base station, a Trimble Trimark 3 Radio Modem was mounted on a small boat which was piloted outside the survey area and served as a repeater.
- Multibeam data was acquired and processed using SWATHplus Processor and Grid and Hypack/Hysweep,

2.2.1.1.2 Survey

Prior to deploying the survey vessel, benchmarks, provided by a Licensed Puerto Rico Land Survey, at Luis Peña (Pusito 1 and 2) and the top of the ridge overlooking Zoni Beach (Julissa 1 and 2) were occupied using the RTK GPS units. There were no problems acquiring signals from these benchmarks as a repeater was used in a separate vessel to maintain communication at all times between the base station and survey vessel. These benchmarks were used during the survey to confirm positional accuracy. This was performed daily.

Prior to starting the survey, the MBS system was calibrated to ensure data accuracy. An MBS system is a complex system that requires complete synchronization of all of its individual instruments. In order for the multibeam sonar to collect accurate bathymetric data, alignment of the following instruments must be calibrated collectively: the sonar head, heading device, and the motion reference unit. SWATHplus Processor and Grid software were used to perform and apply patch test results. During this calibration, data was collected on specific terrain types at different speeds and directions of travel in order to measure the alignment of the sonar system's instruments. Once the Patch Test was completed, the system was corrected for pitch, roll, yaw, and latency, and the results were entered into the SWATHplus Processor software as offsets.

The survey was conducted concurrently with a towed SSS system. A minimum overlap of 10% was maintained with all adjacent survey lines. The study area was surveyed in sections, to efficiently utilize the GPS radio signal's effective range and locations with the best sea conditions.

The objective of the MBS was to collect as much bathymetric information of the bottom as could be safely attained. Due to shallow water conditions and navigational obstructions such as boulders, coral heads, reefs, etc., data coverage did not extend all the way to the shoreline in all areas. These shallow water areas were avoided in order to prevent damaging the environment, and to ensure the safety of the survey crew, the multibeam survey equipment, and the vessel.

2.2.1.1.3 Data Processing

SWATHplus Processor and Grid was used to process raw information gathered from each instrument, including the following data inputs: sonar, heading, GPS, MRU, sound velocity, instrument offsets, and

collective time stamps. Data was filtered to remove noise from the water column and filtered to reject any values outside of that which was possible. As per project requirements, all data had to meet the minimum standard requirements as set forth for IHO Order 1 Standards for Hydrographic Surveys. Each survey line was individually examined for inconsistent and irregular values. Cross lines were examined to see if depths were within 0.25 meters of each other. Although no cross lines in the survey were outside this, if they had been, the day's data would have been reexamined for possible cause, i.e. incorrect offset, speed of sound error, tide correction error. If no error was found then either some or all of the day's data would have been rejected. At this point during data processing, anomalies were rejected and cleaned from the data set.

The dataset was exported as an x,y,z file for final cleaning, as a preparation for final output in Hysweep. Data was again checked for anomalies and, if required, the original data was rechecked. Horizontal and vertical resolution for the MBS system was 0.1 meter. Soundings were then thinned and gridded to create a 0.5 meter by 0.5 meter surface. Copies of the raw and processed MBS data are included in Appendix C of this Report.

2.2.1.1.4 MBS QC

The positioning system QC results showed daily RTK accuracies ranging from 0.0108 to 0.0178 meters. MBS QC involved pre-survey system calibration and patch tests. Additional partial patch tests were run to confirm that no change to the mounting orientation had occurred (none did) since transiting conditions to the work areas were rough. Sound velocity measurements were recorded at the sonar head continuously during data collection. Sound velocity casts of the entire water column were taken twice daily and entered into SWATHplus Processor during data processing. Sound velocity was found to consistent from the water surface to bottom as well as from day to day, with a total range for the entire survey from 1540.971 to 1542.413 m/s. Daily cross lines were also run as an additional QC check. Detailed MBS QC results are included in Appendix E. All MBS QC tests passed and met project requirements.

2.2.1.2 Side Scan Sonar (SSS) Survey

2.2.1.2.1 Instrumentation

An Edgetech 4125-FS dual frequency 400kHz/900kHz CHIRP side SSS system was the SSS system used for this survey. This system had an across track horizontal resolution of 2.3 cm for the 400 kHz frequency and 1.5 cm for the 900 kHz frequency. Positioning was supplied by the same RTK positioning system as the multibeam system used. The offsets from the antenna mounting position were measured and entered into the sonar acquisition software prior to commencing the survey. During the survey, the amount of cable out was recorded and used for layback corrections during data processing.

2.2.1.2.2 Survey

Range scale was set to 50 and 75 meters depending on how close the survey vessel could approach the shore, which resulted in 200 percent or greater insonification of the survey areas. Data quality was monitored real time as well as the towfish altitude. The cable tender was in constant communication with the sonar operator to ensure the towfish maintained a safe altitude above the sea floor.

2.2.1.2.3 Data Processing

The sonar records were mosaiced using Chesapeake Technologies Sonar Wiz Map 5.0 software to provide a better overall view of the areas surveyed, and to produce a single geo-referenced image of the survey areas. This image was combined with the multibeam results in Hypack 2013 to allow better interpretation of the data sets. Each individual sonar file was bottom tracked through a combination of automated bottom tracking as well as manual inspection and correction of inaccurate bottom detection. Gains were adjusted to level out the intensities of the bottom returns across the sonar ping. Navigational corrections for layback were applied as necessary. Layback accuracy was checked by reviewing records for isolated objects or edges of reefs and comparing their plotted locations on survey lines run in opposite directions.

The primary frequency used for analysis was 900 kHz due to the greater amount of detail in the sonar records. The mosaics were output in sections as geo-tiffs with a resolution of 0.1 meters per pixel. Though this was at a lower resolution than the raw data, this resolution gave sufficient detail in the sonar mosaics while allowing manageable file sizes.

Post analysis of the SSS data, to identify potential MPPEH, did not reveal any obvious targets indicative of ordnance items because of the abundant number of benthic features in the data. Given that the majority of the observed benthic features were similar in size and shape, they effectively flooded out or camouflaged any MPPEH targets in the sonar mosaic data. Therefore, no shapefiles for MPPEH targets were created after Phase 1A was completed. The lack of SSS MPPEH targets does not mean that MPPEH items are absent from an area. Phase 2 (EM Survey) and Phase 3 (Intrusive Investigation) of the underwater RI will further define the presence or absence of MPPEH.

Copies of the raw and processed SSS data are included in Appendix C of this Report.

2.2.1.2.4 SSS QC

Prior to departing the dock each day, the SSS was powered and the towfish functionality was tested with a ‘rub test’. SSS QC involved towing the sonar past a known fixed object on the seafloor each day. For SSS QC purposes, the survey areas were divided into two general regions (the western cayos and the eastern cayos/Culebrita). Within each region, an isolated bottom feature (rock) was selected for daily use. The feature within each region was initially scanned on multiple passes in different directions to determine its location. The initially surveyed in position was used as the value to which all future daily QC passes were compared. The results of the daily QC passes relocated the features within a maximum distance of 1.8 meters.

2.2.1.3 Revised RI Transect Design

Based on the results of the multibeam, SSS surveys, and analysis of the NOAA benthic GIS files, transects were revised to maximize the efficiency of the survey while minimizing the potential environmental impact and still maintained sufficient coverage to obtain the desired results. The most efficient way of surveying while minimizing the environmental impact involved creating transects which roughly followed the bathymetric contours and habitat types. The multibeam data provided high resolution bathymetry for the initial revised transect positioning. As different bottom types have different acoustic reflectivities, the SSS images allowed for rough differentiation of bottom types. Areas which have both highly reflective surfaces and large numbers of shadows are typical of hard coral reef or large rocks or boulders. Grass beds have the appearance of fine sand paper showing a light texture without shadows. Areas of pure sand are typically seen as a wavy bottom. As soft corals do not reflect sound well, they are difficult to image acoustically and do not show up well in the SSS results. An initial determination of survey methodology to be used on each section of transect was also made based on the remote sensing results, and were taken into account during the planning of the proposed transects (Figures A-6 through A-10 in Appendix A). Proposed transects within Tortuga Bay were reoriented to run in and out of the bay as opposed to across the bay due to the coral reefs that line both sides of the bay. The reoriented lines are more efficient for surveying as well as minimizing the chance of environmental impact during survey operations. These proposed transects were then surveyed in Phase 1B to ground truth the remote sensing results, verify the benthic habitat types and finalize proposed methodology per transect section as illustrated in Figure 2-1 below.

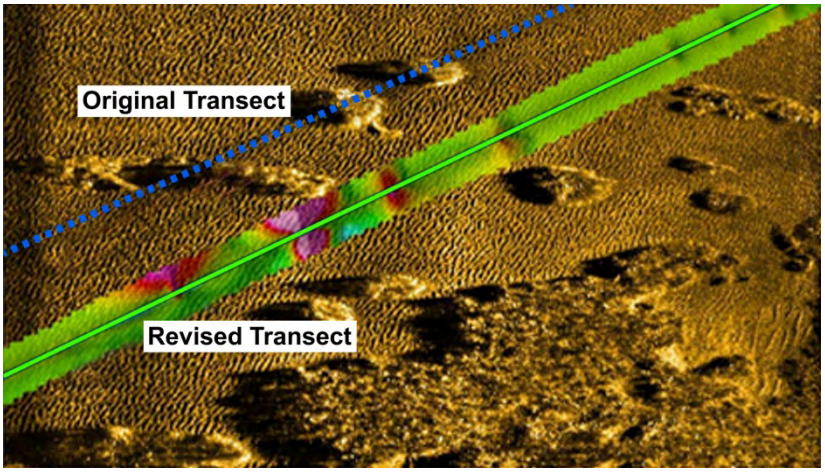

Figure 2-1: Example RI Transect Re-alignment

2.2.2 Phase 1B Data Collection Activities

2.2.2.1 Underwater Video Transect Surveys

Where water depths and site conditions allow access by boat, an U/W video camera was deployed and monitored as the vessel progressed down each of the re-aligned RI transects. The survey vessel was accurately maneuvered through the use of navigation software displaying the re-aligned transects connected to the RTK-DGPS, while a marine scientist and Unexploded Ordnance (UXO) Technician monitored the video display. Digital video footage was recorded onto a digital video recorder and laptop computer, noting the latitude and longitude of the camera position. The ASI marine scientist monitored the video feed to make preliminary notes of the various U/W benthic habitats. The UXO Technician noted any suspected MEC items that were encountered during the survey. In addition, a post survey review of the video footage was conducted by the ASI marine scientist who then compared the visual data to the NOAA U/W benthic habitat GIS data. Coverage maps showing the GPS track log of the video surveys are contained in Appendix A (Figures A-11 through A-15).

U/W video transect surveys were conducted IAW with the EBS WP and adhered to the SOP, *Endangered Species and Conservation and Their Critical Habitat During Underwater Investigations at DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico*.

2.2.2.2 Snorkeling Transects

The primary purpose of snorkeling operations was to collect supplemental EBS data (i.e., depth soundings and visual video survey, etc.) within shallow water areas (less than 4 ft of depth) of the MRSs. Snorkeling operations were conducted in order to complete the following tasks:

- Visual surveys of the sea floor to survey marine habitat types
- Visual survey of suspected MEC items
- Collection of related U/W data (water depth, site conditions, etc.)

Snorkelers completed surveys of the sea floor, advancing along the required distance of idealized transect lines while visually surveying a 5-ft-wide path. Snorkelers utilized a hand held GPS enabled Personal Digital Assistant (PDA) to navigate the preplanned transects. Snorkelers were also equipped with U/W digital video cameras to photograph/shoot video of the U/W habitat. Snorkeling activities satisfied the related project DQOs. Coverage maps showing the GPS track log of the snorkel video surveys are contained in Appendix A (Figures A-11 through A-15). The video data collected by the snorkelers is included in Appendix D. The findings are discussed in detail in Section 3.5 of this EBS Report.

USA conducted snorkeling activities IAW the Snorkeling Plan (SP), Appendix N of the EBS WP. The SP reflects the procedures and methods Parsons/USA established and USA utilized to safely perform snorkeling surveys of the shallow U/W environment in support of subsequent EBS activities. USA personnel also conducted snorkeling activities IAW the SOPs contained in Appendix M of the EBS WP.

2.2.2.3 VideoRay Surveys

2.2.2.3.1 Biological Spot Investigations

Following the video transect survey, locations were chosen within each MRS to visit with the ROV in order to collect representative video of habitat types present. Locations were chosen based on video images from the transects as well as from the results of the MBS and SSS surveys. The previously collected data showed the great majority of the areas surveyed contained corals of some type, therefore the proposed methodologies for future activities would be non-contact. Only a limited variety of bottom types were seen in the previously collected data sets. Due to this, only a few locations were chosen to get more detailed information about those habitats and species present. Listed threatened and endangered species were identifiable during the video transect survey, therefore revisiting locations with the ROV was determined not to be necessary.

Eleven locations were chosen at MRS 02 (10 associated with potential MPPEH items and 1 for biologic investigation), and three locations were chosen at MRS 07 for biological investigation. Results of the ROV investigations assisted with species identification and provided representative images of the habitats. Figures A-16 through A-20 (Appendix A) and Table 2-2 below provide the locations and information related to each of the biological spot investigations conducted within MRSs 07 and 02.

2.2.2.3.2 MPPEH Investigations

Items that visually reflected characteristics of MPPEH items were reacquired and investigated further with the ROV, as required in order to capture the position, record video footage of the item, and document the surrounding U/W environment. USA located 11 suspected MPPEH items which were all located within MRS 02. For the purposes of safety, the locations of these items are not being disclosed outside of USACE preview. MPPEH items during the EBS could not be confirmed as MEC or MD and were classified as MPPEH. The RI will evaluate these items and further define as MEC or MD.

2.2.2.3.3 Phase 1B QC

Daily QC checks on the RTK's accuracy (11-cm repeatability) along with operational checks on the underwater video/ROV/handheld cameras were completed prior to the days evolutions. QC checks on the GEO XT (2-m repeatability) were performed when Snorkeling Video Transects were conducted (See Appendix E).

2.2.3 QC Inspections/Audits

The UXOSO/UXOQCS conducted preparatory, initial, and follow-up inspections as specified in Table 4.1 of the Work Plan to ensure all work was performed IAW the Work Plan. The UXOSO/UXOQCS verified that site personnel performed operational checks of instruments and equipment prior to using them onsite. The results of the inspections are documented on the QC Surveillance Forms included in Appendix E. No deficiencies or non-conformance issues were observed or noted.

This page is intentionally left blank.

Table 2-2: Biological Spot Investigations (ROV)

Location ID	Description	Photo ID (Appendix D)	Longitude	Latitude	Benthic Habitat Classification
MRS 02- 1	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan)	MRS 02- 1 Alcarazza 1	249726.43	2031627.21	Coral Reef and Colonized Hardbottom
MRS 02- 2	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan), *Montastraea sp.* **(star corals), tube sponges, barrel sponges	MRS 02- 2 Alcarazza 2	249821.26	2031714.42	Coral Reef and Colonized Hardbottom
MRS 02- 3	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan)	MRS 02- 3 Alcarazza 3	249855.21	2031792.68	Coral Reef and Colonized Hardbottom
MRS 02- 4	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan), tube sponges, barrel sponges	MRS 02- 4 Alcarazza 4	249713.83	2031892.54	Coral Reef and Colonized Hardbottom
MRS 02- 5	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan), tube sponges, barrel sponges	MRS 02- 5 Alcarazza 5	249834.94	2031818.98	Coral Reef and Colonized Hardbottom
MRS 02- 6	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan), *Montastraea sp.* **(star corals), *Dendrogyra cylindricus***(Pillar coral)	MRS 02- 6 Lobito 1	247252.68	2029037.45	Coral Reef and Colonized Hardbottom
MRS 02- 7	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan), *Montastraea sp.* **(star corals), *Dendrogyra cylindricus***(Pillar coral), tube sponges, barrel sponges	MRS 02- 6 Lobo 1	248402.92	2027703.33	Coral Reef and Colonized Hardbottom
MRS 02- 8	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan), *Montastraea sp.* **(star corals), tube sponges	MRS 02- 6 Lobo Bio	248902.44	2027287.05	Coral Reef and Colonized Hardbottom
MRS 02- 9	Sea Rods (various species), *Gorgonia ventalina* (common sea fan), *Montastraea sp.* **(star corals)	MRS 02- 6 Somb 1	262809.01	2029008.98	Coral Reef and Colonized Hardbottom
MRS 02- 10	Sea Rods (various species), *Pseudopterogorgia sp*. (sea plumes), *Gorgonia ventalina* (common sea fan), *Montastraea sp.* **(star corals), barrel sponges	MRS 02- 6 Tib 1	263384.72	2029791.64	Coral Reef and Colonized Hardbottom
MRS 02- 11	Sea Rods (various species), *Pseudopterogorgia sp*.(sea plumes), *Gorgonia ventalina* (common sea fan)	MRS 02- 6 Tib 2	263458.07	2029906.42	Coral Reef and Colonized Hardbottom
MRS 07- 1	*Syringodium filiforme* (manatee grass), *Halimeda sp*.(leaf algae), *Dictyota sp.* (Y-branched algae)	MRS 07- 7 Bio1	264295.84	2027175.63	Submerged Vegetation-Macro algae
MRS 07- 2	*Syringodium filiforme* (manatee grass), *Thalassia testudinum* (turtle grass),), *Halimeda sp*. (leaf algae), *Dictyota sp*. (Y-branched algae)	MRS 07- 8 Bio 2	264370.40	2027027.82	Submerged Vegetation-Macro algae
MRS 07- 3	*Syringodium filiforme* (manatee grass), *Thalassia testudinum* (turtle grass), *Halimeda sp*. (leaf algae), *Dictyota sp*. (Y-branched algae) *NOTES: (*) indicates a species currently listed as threatened or endangered* *(**) indicates a species proposed for listing as threatened or endangered*	MRS 07- 9 Bio 3	264487.59	2027041.54	Submerged Vegetation-Macro algae

This page is intentionally left blank.

CHAPTER 3. EBS RESULTS

3.1 ENDANGERED SPECIES ACT AND NATIONAL WILDLIFE REFUGE BACKGROUND INFORMATION

The main island of Puerto Rico and its associated islands support 75 federally listed threatened and endangered species consisting of 26 animals and 49 plants. Among this diverse group of fauna and flora are multiple species that are known to exist, potentially exist, or temporarily use areas within the Culebra Island archipelago. Of the 75 federally listed species, nine are known or are suspected to occupy Culebra Island and/or the associated cayos. In addition to the federally listed species, two state-listed species are known to occupy Culebra Islands. The federally and state-listed species include both terrestrial and marine life. The federally listed species of most concern for the wildlife refuge are the green sea turtle, hawksbill sea turtle, leatherback sea turtle, and loggerhead sea turtle. Due to declining populations, the elkhorn and staghorn corals in the surrounding waters are federally listed as threatened species. In addition to the species listed under the Endangered Species Act (ESA), the Center for Biological Diversity petitioned NMFS on 20 October 2007 to list 83 species of corals as threatened or endangered under the ESA, and to designate critical habitat for these corals. NMFS received and reviewed the petition and determined that the requested listing actions may be warranted for 82 of the 83 coral species. The completed status review and management report (NOAA Technical Memorandum NMFS-PIFSC-27) was issued in September of 2011. All of the Atlantic coral species have the potential to be found in waters around Culebra.

According to the National Wildlife Refuge (NWR) System, portions of Culebra Island and 22 of the associated cayos are considered NWR area. The three largest cayos are Culebrita, Cayo Norte (privately owned), and Luis Peña. These resemble Culebra in that they all have sandy beaches, rugged coastline, and gentle to steep hills. Vegetation ranges from moderate to extremely dense. The smaller cayos are primarily solid rock with sparse or no vegetation. A few of the smaller cayos have small beaches; however, most are rugged rock all around.

According to the PR DNER, the conservation priority areas for Culebra and associated cayos are as follows:

- All of the lagoons on Culebra
- Sea grass beds
- Monte Resaca
- All beaches around Culebra
- The designated critical habitat area for the Virgin Islands Boa
- Flamenco Peninsula
- Puerto del Manglar
- Los Canos
- Punta Soldado
- Ensenada Cementerio
- All cayos around Culebra
- The Culebra NWR
- The Canal Luis Peña Natural Reserve

3.2 OBSERVED BENTHIC HABITAT TYPES

3.2.1 Description of Observed Benthic Habitats in MRSs 07 and 02

The following section provides a description of the results from the benthic habitat analysis performed by Parsons/USA. Parsons/USA utilized the data collected from hydrographic (Appendix C) and U/W towed camera video surveys which includes snorkeler video surveys (Appendix D), along with the NOAA benthic GIS, to characterize the benthic habitat classifications. The multibeam data provided high resolution bathymetry for aiding in the SSS interpretation. The SSS data was used for initial bottom classifications. As different bottom types have different acoustic reflectivities, the SSS images allowed for rough differentiation of bottom types. Areas that have both highly reflective surfaces and large numbers of shadows are typical of hard coral reef or large rocks or boulders. Grass beds have the appearance of fine sand paper showing a light texture without shadows. Areas of pure sand are typically seen as a wavy bottom. As soft corals do not reflect sound well, they are difficult to image acoustically and do not show up well in the SSS results. The video survey performed by towed U/W camera and snorkeler video survey data allowed for the ground-truthing of the bottom classifications from the multibeam/SSS surveys as well as the identification of species present and allowing areas of soft corals to be properly classified.

According to the NOAA GIS effort (Kendall, M.S., et al. 2001), there are twenty-six (26) distinct benthic habitats located within near shore waters of Puerto Rico and the U.S. Virgin Islands. The NOAA dataset was loaded into GIS software and used in conjunction with the results of Phase 1A and 1B surveys in evaluating benthic habitats present within the survey areas. During the course of completing the EBS analysis, it was observed that the benthic habitats located within the water portions of MRSs 07 and 02 consist primarily of unconsolidated sediments (sand), submerged vegetation (sea grass/macro algae), and coral reef/hard bottom (colonized and uncolonized pavement) habitats. For the purposes of evaluating the implementability of subsequent RI fieldwork actions (conducting geophysical surveys and intrusive investigations), Parsons/USA simplified these bottom types into two main benthic habitats, unconsolidated sediments/submerged vegetation and coral/hard bottom classifications. The following paragraphs summarize observations for these two classifications. Figures A-21 through A-25 in Appendix A illustrate the benthic classifications projected on GIS within both MRSs 02 and 07.

3.2.2 Unconsolidated Sediments/Submerged Vegetation

The unconsolidated sediments habitat classification consists primarily of mud or sand with varying coverage (density) of submerged vegetation (sea grass and macro algae). Within MRS 07, submerged vegetation populated the unconsolidated sediment habitats within the shallow waters to the south and west of Culebrita Island and within Tortuga Bay. For MRS 02, areas of sand primarily included scattered rocks/coral heads. Some areas contained individual corals or rocks that were distinctive but made up a very small percentage of the total cover. Species identified in this habitat type included, but are not limited to: *Thalassia testudinum* (turtle grass), *Syringodium filiforme* (manatee grass), *Dictyota sp.* (Y-branched algae), and *Halimeda sp*. (leaf algae).

3.2.3 Colonized or Uncolonized Hard Bottom and Coral Reef

The second observed class consisted of colonized or uncolonized hard bottom and coral reef. This class also included scattered coral or rock in unconsolidated sediment. In both MRS 07 and 02 the majority of hard bottom structure was considered to be the pavement cover in the form of flat, low-relief, solid carbonate rock, with coverage of macroalgae, hard coral, zoanthids, and other sessile invertebrates that are dense enough to have begun to obscure the underlying surface. The various species identified included but are not limited to: *Sea rods* (various species), *Pseudopterogorgia sp*. (sea plumes), *Gorgonia ventalina* (common sea fan), *Acropora palmata* (elkhorn coral), *Acropora cervicornis* (staghorn coral), *Dendrogyra cylindricus* (pillar coral), *Montastraea sp.* (star corals), *Siderastrea sp*. (starlet coral), and *Diploria sp.*(brain corals). It should be noted that video resolution during the transect survey did not allow species-level classification the *Montastraea* corals observed. Therefore they are only classified to the genus level. These areas appear in the SSS mosaic as rough in texture and having closely packed light and dark spots caused by the high reflectivity and vertical relief of the structures.

For representative photographs and further description of these two habitat classifications, please refer to Appendix Q of the WP as well as the ROV video footage in Appendix D of this document.

3.3 PRESENCE OF ESSENTIAL FISH HABITATS

Essential fish habitat (EFH) is identified for species managed in Fishery Management Plans under the Magnuson-Stevens Fishery Conservation and Management Act. EFH is the habitat necessary for managed fish to complete their life cycle, thus contributing to a fishery that can be harvested sustainably. EFH applies to each life stage of approximately 1,000 managed species. Different life stages of the same species often use different habitats. Habitat types used by different life stages of fish include sand bottoms, submerged aquatic vegetation, coral reefs, and mangrove areas. Submerged aquatic vegetation helps stabilize sand and mud bottoms, filter polluted runoff, provide living space and refuge from predators. It acts as a food source as well as a nursery area for fish, crabs, and other aquatic species. Coral reefs support sharks, turtles, and more than 4,000 species of fish worldwide. They offer refuge from predators as well as places to feed and reproduce. Mangrove areas serve as spawning grounds, nurseries, and shelter for different life stages of various fish. As identified by the NOAA EFH mapper, the waters around Culebra have the potential to be EFHs for corals, queen conch, two species of lobster, three species of shark, and 43 different species of fish at either certain stages of or through their entire life cycle.

3.4 PRESENCE OF THREATENED AND ENDANGERED SPECIES

3.4.1 Federally Listed Species Potentially Present

3.4.1.1 Endangered Species (Descriptions in the EBS WP):

- *Balaenoptera musculus* (Blue whale)
- *Balaenoptera physalus* (Fin whale)
- *Megaptera novaeangliae* (Humpback Whale)
- *Balaenoptera borealis* (Sei Whale)
- *Physeter macrocephalus* (Sperm Whale)
- *Trichechus manatus mantus* (Antillean Manatee)
- *Eretmochelys imbricata* (Hawksbill Sea Turtle)
- *Dermochelys coriacea* (Leatherback sea turtle)
- *Trichechus manatus mantus* (Antillean Manatee)

Manatees are most abundant along the south and east coasts of the main island, particularly in the area of Fajardo and Ceiba and in the Jobos Bay area between Guayama and Salinas. Manatees are rarely seen in Culebra and do not tend to stay for extended periods as there are no reliable sources of fresh water (Caribbean Stranding Network, unpubl. data).

3.4.1.2 Threatened Species (Descriptions in the EBS WP)

- *Chelonia mydas* (Green sea turtle)
- *Caretta caretta* (Loggerhead sea turtle)
- *Acropora cervicornis* (staghorn coral) is currently listed as a threatened species and is being considered for change to endangered species status. It is found in shallow waters from 1 to up to 160 feet depending on water conditions (though rarely seen below 60 feet). Colonies form antler-like racks of cylindrical branches that often grow in great tangles. The surface is covered in small, protruding, tubular corallites. Live staghorn coral is brown to yellow-brown. Once abundant throughout the region, it suffered mass mortality since the early 1990s in many areas due to white band disease. Though it was not observed in waters greater than 20 feet during the

video transect survey, it has the potential to be in deeper water, therefore, all areas of reef within both MRSs were considered to have staghorn present.

- *Acropora palmata* (elkhorn coral) is currently listed as a threatened species and is being considered for change to endangered species status. It is found in shallow waters from 1 to up to 55 feet depending on water conditions (though rarely seen below 35 feet). Colonies form flattened branches resembling the horns of moose or elk. The surface is covered in small, protruding, tubular corallites. Live elkhorn coral is brown to yellow-brown. Once abundant throughout the region, it suffered mass mortality since the early 1990s in many areas due to white band disease. Though it was not observed in waters greater than 20 feet during the video transect survey, it has the potential to be in deeper water, therefore all areas of reef within both MRSs are considered to have elkhorn present.

As both MRSs 02 and 07 contain live specimens of the staghorn and elkhorn corals, areas of these MRSs should be considered critical habitat (CH) for these species as well as for the green sea turtle for the planning of future activities.

NOAA is proposing that the currently threatened species be changed to endangered status as well as adding seven more Caribbean coral species to the threatened and endangered species list. These additional potentially endangered species include *Dendrogyra cylindricus* (pillar coral), *Montastraea annularis* (boulder star coral), *Montastraea faveolata* (mountainous star coral), *Montastraea franksii* (mountainous star coral), *Mycetophyllia ferox* (rough cactus coral) all of which are, or have the potential to be, located within the waters surrounding Culebra. The additional potentially threatened species include *Dichocoenia stokesi* (elliptical star coral) and *Agaricia lamarki* (Lamarck's sheet coral) which also are, or have the potential to be, located within the waters surrounding Culebra. While not currently included on the endangered/threatened species list at the time of the writing of this report, the areas in which they are found were not impacted by survey activities. All future survey activities in areas of coral will be conducted using remote sensing equipment which does not contact the seafloor, therefore, these potentially listed species should not be impacted in the future.

3.4.2 Critical Habitat

Critical habitat (CH) is designated for the survival and recovery of species listed as threatened or endangered under the ESA. CH includes those areas occupied by the species, in which are found physical and biological features that are essential to the conservation of an ESA listed species, and which may require special management considerations or protection. As of 2 September 1998, all waters surrounding Culebra from the high water mark out 3 nautical miles, as well as the surrounding cayos, were designated as CH for the green sea turtle. Green sea turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting. These conditions are present at both MRSs 02 and 07.

3.4.3 Threatened or Endangered Species Observed

During all phase 1A and 1B survey activities, avoidance measures were strictly followed as defined in the USACE SOP, *Endangered Species and Conservation and Their Critical Habitat During Underwater Investigations at DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico*. Threatened species observed included staghorn and elkhorn corals as well as green sea turtles. Proposed threatened or endangered species that were seen during video and snorkeling surveys included *Montastraea sp* (star corals) and *Dendrogyra cylindricus* (pillar coral). During phase 1A operations, the MBS transducer was at the same depth as the vessel hull. The altitude of the SSS towfish was monitored real-time during survey operations and the cable tender was in constant communication to insure the towfish did not contact the bottom. During phase 1B, the previously collected bathymetry data was displayed along with the NOAA chart in relation to the vessel position to predict depth changes and allow the camera to be raised before contacting the bottom. The camera was also deployed at a fairly high

altitude which, while not always allowing species specific identification of corals, minimized the chance of bottom contact. One nearly 10 meter tall boulder was contacted as described in section 3.6.2. Following the impact, the camera was flown at an even greater altitude to protect the environment.

At MRS 02, no sea turtles were observed. Staghorn and/or elkhorn corals were observed at 8 of the 12 cayos. *Montastraea sp* (star corals) were present at all cayos. *Dendrogyra cylindricus* (pillar coral) was observed at 7 of the cayos of MRS 02. Detailed information about which species were observed at each cayo can be found in Section 3.5.

At MRS 07 one hawksbill turtle, currently on the endangered species list, was encountered during the Phase 1 survey activities. It was observed during the video transect survey off of transect 1B. It was on the surface, greater than 50 meters to seaward of the vessel, and appeared to swim off in the opposite direction. Constant observation did not show the turtle to reappear and as the turtle was beyond 50 meters, the survey continued at idle speed. The survey vessel departed the survey area at idle speed to insure no accidental contact would be made should the turtle reappear suddenly. Green sea turtles were observed within Tortuga Bay. Turtles ranged in size from approximately 1 foot to 3 feet long. None were observed within 50 meters of the survey vessel while the surveying was underway. When the vessel was moored, turtles were seen within a 20 meter radius around the moored vessel as the turtles swam past the vessel. Since the vessel was moored and was not moving, the vessels presented no risk to the turtles. During snorkeling operations, turtles were observed by the snorkelers and avoidance measures were taken, ensuring the turtles were not harassed per the previously referenced SOP. Sea turtle sightings are summarized in Table 3-1 and the observation logs are included in Appendix E. Elkhorn corals were seen off the southern coast of Culebrita, off the north and east sides of Cayo Botella, and on the shallow reefs on the east and west sides of Tortuga bay. Staghorn coral was seen in the same areas as the elkhorn coral as well as along much of the western side of Culebrita and south of Cayo Botella. *Montastraea sp* (star corals) were observed as a basic reef building coral within the MRS. Appendix A (Figures A-26 through A-30) provides maps with locations for “listed” coral species witnessed during Phase 1.

Table 3-1: Sea Turtle Sighting Summary Table

Type	Date	MRS	Lat/Long
Green Sea Turtle	8-13-13	MRS 7	18 19’ 11.36 N / 65 13’ 36.81 W
Hawksbill Turtle	8-21-13	MRS 7	18 18’ 4025 N / 65 13’ 16.54 W
Green Sea Turtle	8-22-13	MRS 7	18 19 10.26 N / 65 13’ 49.06 W
Green Sea Turtle	8-22-13	MRS-7	18 19.141’N / 65 13.721’ W

3.5 DETAILED FINDINGS WITHIN EACH MRS

3.5.1 MRS 02

The MRS 02 contains 99.8% of Reef/Colonized Bedrock and 0.132% of Sand.

3.5.1.1 Cayo Lobito

The sea floor surrounding Cayo Lobito consists primarily of relatively steep slopes with large rocks and boulders which transition into a more level bottom roughly 75 to 100 meters from the shoreline. The steep slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*.(sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Acropora palmata* (elkhorn coral), *Acropora cervicornis* (staghorn coral), and *Dendrogyra cylindricus* (Pillar coral) as well as other hard corals. Elkhorn and

staghorn corals were observed in relatively shallow waters along the eastern side of the cayo. Pillar coral was seen off the eastern side as well as on the western side near the north point. Though the outer transect appears to transit sections of relatively smooth bottom, the U/W video inspection revealed very limited clean sand areas. Areas of sand seen typically had scattered rocks with soft coral growth.

3.5.1.2 Cayo Lobo

The sea floor along the eastern side of Cayo Lobo consists primarily of relatively steep slopes with large rocks and boulders which transition into a more level bottom roughly 50 to 100 meters from the shoreline. Areas along the western shore have relatively shallow flat areas extending up to 50 meters from the shoreline where they then drop off rapidly to deeper water. The steep slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), and *Acropora palmata* (elkhorn coral) as well as other hard corals. In the shallow flat areas, *Acropora cervicornis* (staghorn coral), and *Dendrogyra cylindricus* (Pillar coral) were observed. Elkhorn coral was seen off the southeastern shoreline. An area of staghorn corals (some with a relatively dense population) were observed in relatively shallow waters along the southeastern side of the cayo. Pillar coral was seen off the southern point as well as on the western side near the north point. Though the outer transect appears to transit sections of relatively smooth bottom, the U/W video inspection revealed very limited clean sand areas. Areas of sand typically seen had scattered rocks with soft coral growth.

3.5.1.3 El Mono

The sea floor surrounding El Mono consists primarily of a slope with large rocks and boulders which continues to the edge of the MRS through most of the area surveyed. The slopes and rocks are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*.(sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals) as well as other hard corals. Elkhorn and staghorn corals were not observed during the video survey.

3.5.1.4 Cayo Yerba

The sea floor surrounding Cayo Yerba consists primarily of relatively steep slopes with large rocks and boulders which transition into a more level bottom roughly 60 meters from the shoreline. The slopes along the southeastern shoreline are more gradual. The slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Acropora cervicornis* (staghorn coral), and *Dendrogyra cylindricus* (Pillar coral) as well as other hard corals. Staghorn corals were observed in relatively shallow waters along the southeastern side of the cayo. A roughly 100 meter section of the inner transect at the southeast corner of the cayo contains a relatively dense collection of staghorn colonies. Though the outer transect appears to transit sections of relatively smooth bottom, the U/W video inspection revealed those areas to be inhabited by soft corals.

3.5.1.5 Cayo Raton

The sea floor surrounding Cayo Raton consists primarily of relatively steep slopes with large rocks and boulders which transition into a more level bottom roughly 80 or more meters from the shoreline. The slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include Montastraea sp. (star corals), and *Dendrogyra cylindricus* (Pillar coral) as well as other hard corals. Pillar coral was seen on all sides of Cayo Raton, though no dense concentrations of colonies were observed. The outer transect appears to transit sections of relatively smooth bottom, however, the U/W video inspection revealed those areas to be inhabited by soft corals.

3.5.1.6 Cayo del Agua

The sea floor along the southwest side of Cayo del Agua consists primarily of relatively steep slopes with large rocks and boulders which continue to drop off more than 100 meters from the shoreline. The slopes along the eastern and northern sides of the island are more gradual. The slopes are covered in soft corals including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Acropora cervicornis* (staghorn coral), and *Dendrogyra cylindricus* (Pillar coral) as well as other hard corals. Staghorn corals were observed in relatively shallow waters along the southern side of the cayo. Pillar coral colonies were seen along the southern and eastern side of the island. Though the outer transect appears to transit sections of relatively smooth bottom, the U/W video inspection revealed those areas to be inhabited by soft corals.

3.5.1.7 Piedra Stevens

The sea floor surrounding Piedra Stevens consists primarily of relatively steep slopes with large rocks and boulders which drop off until 60 to 100 meters from shore where the angle of slope significantly decreases. The slope off the southern point is more gradual, dropping to roughly 10 meters of depth 100 meters from shore. The slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals) as well as other hard corals. No staghorn or elkhorn corals were seen during the video transect survey.

3.5.1.8 Los Gemelos

The islands of Los Gemelos are oriented in a roughly northeast to southwest orientation. The sea floor from the center of the island pair to the northeast consists primarily of relatively steep slopes with large rocks and boulders which drop off until 60 to 100 meters from shore where the angle of slope significantly decreases. The slope off the southwestern half is much more gradual, dropping to as little as 5 meters of depth 100 meters from shore. The slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Dendrogyra cylindricus* (Pillar coral) as well as other hard corals. No staghorn or elkhorn corals or other corals proposed for listing were seen during the video transect survey. Though the outer transect appears to transit sections of relatively smooth bottom off the northeast corner of the cayos, the U/W video inspection revealed those areas to be inhabited by soft corals.

3.5.1.9 Alcarraza

The sea floor along the east, west, and southwest sides of Alcarraza consists primarily of relatively steep slopes with large rocks and boulders which continue to drop off more than 100 meters from the shoreline. The slopes off the north, west, and south points of the island are more gradual. The slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals) and *Acropora palmata* (elkhorn coral) as well as other hard corals. A single elkhorn colony was seen to the south of the eastern point of the island, on top of a large boulder. Though the transects appear to transit sections of relatively smooth bottom, the U/W video inspection revealed those areas to be inhabited by soft corals, or have rock covered bottoms for relatively short distances.

3.5.1.10 Sombrerito

Cayo Sombrerito is a small island located off of the southeast point of Cayo Norte. A very shallow area between Cayo Sombrerito and Cayo Norte prevents the safe passage of a boat, therefore, transects only pass along 3 of the sides. The sea floor consists primarily of relatively steep slopes with large rocks and boulders which transition into a more level bottom roughly 30 meters from the shoreline where it transitions into a much more gradual slope. Areas along both sides of the cayo near the southern extent

of the transects have relatively shallow gently sloped areas extending more than 100 meters from the shoreline. The slopes are sparsely covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*.(sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Acropora cervicornis* (staghorn coral), *Acropora palmata* (elkhorn coral) as well as other hard corals. The staghorn corals were seen in scattered colonies in the shallow waters off the southeastern side of the cayo. Elkhorn coral was seen off the southeastern shoreline in roughly the same areas as the staghorn coral. A single elkhorn colony was also seen in the shallow water of the southwestern side of the cayo. Though the outer transect appears to transit sections of relatively smooth bottom, the U/W video inspection revealed very limited clean sand areas (approximately 60 meters of the outer transect).

3.5.1.11 Cayo Tiburon

The sea floor surrounding Cayo Tiburon consists primarily of relatively steep slopes with large rocks and boulders along the north and west sides which drop off to greater than 20 meters of depth approximately 100 meters from shore. The east and south sides have much more gradual slopes and drop off to approximately 10 meters of depth 100 meters from shore. The slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Acropora cervicornis* (staghorn coral), *Acropora palmata* (elkhorn coral), *Dendrogyra cylindricus* (Pillar coral) as well as other hard corals. The staghorn and elkhorn corals were seen in scattered colonies in the shallow waters off the southeastern side of the cayo. Two pillar coral colonies were seen in relative close proximity to each other off the eastern side of the cayo. Though the outer transect appears to transit sections of relatively smooth bottom, the U/W video inspection revealed very limited clean sand areas.

3.5.1.12 Cayos Geniqui

The sea floor surrounding Cayos Geniqui consists primarily of very steep slopes with nearly vertical faces and large rocks and boulders along the north and east sides which drop off to greater than 35 meters of depth approximately 100 meters from shore. The west and south sides have much more gradual slopes and drop off to approximately 10 meters of depth 100 meters from shore. The slopes are covered in soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Acropora cervicornis* (staghorn coral), and *Acropora palmata* (elkhorn coral) as well as other hard corals. The staghorn and elkhorn corals were seen in scattered to very dense colonies in the shallow waters off the western side of the cayo. Though the outer transect appears to transit sections of relatively smooth bottom, the U/W video inspection revealed very limited clean sand areas. Certain sections of bottom could not be surveyed due to site conditions. These areas were off the eastern side of the cayo which is the windward and exposed side of the island. In those areas it was determined that there was too great a risk of contacting the bottom with the survey equipment due to the nature of the submerged topography. The near vertical faces so close to the shoreline and steep drop offs would not allow sufficient reaction time for the survey vessel and crew to avoid damaging wildlife and/or equipment. Attempts were made to visit those locations with the ROV, however, due to their proximity to shore it was deemed unsafe under anything but ideal conditions which were stated to rarely exist at the site.

3.5.2 MRS 07 - Culebrita

The waters within the Culebrita MRS contain several more types of benthic habitats compared to MRS 02. The majority of the seafloor is colonized hard bottom (49.5%), reef, and scattered coral heads (23.5%). These bottom types are found along the southeast, south, and west sides of Culebrita as well as on both sides of Tortuga Bay and off the northeast point. Within Tortuga Bay there are patches of turtle grass, manatee grass (Seagrass/Continuous 9.32%; Seagrass/Patchy 6.75%), and various macro algaes and y-branching algae. The shallow waters off the southern shore are primarily coral rubble with turtle grass and macro algae or sand (10.9%) with scattered coral heads.

Water depths off the western side of the island, around Cayo Botella, and over the reef along the eastern and western sides of Tortuga Bay, typically do not get deeper than 5 meters. Waters within Tortuga bay reach a maximum depth of 13.9 meters. The transects off the northeast point reach a depth of up to 23 meters.

The MRS contains soft corals, including but not limited to sea rods (various species), *Pseudopterogorgia sp*. (sea plumes), and *Gorgonia ventalina* (common sea fan). Hard coral species present include *Montastraea sp*. (star corals), *Acropora cervicornis* (staghorn coral), and *Acropora palmata* (elkhorn coral) as well as other hard corals. Elkhorn corals were seen off the southern coast of Culebrita, off the north and east sides of Cayo Botella, and on the shallow reefs on the east and west sides of Tortuga bay. Staghorn coral was seen in the same areas as the elkhorn coral as well as along much of the western side of Culebrita and south of Cayo Botella.

3.6 DIFFICULTIES ENCOUNTERED AND LESSONS LEARNED

3.6.1 Weather

Due to exposed locations of the Cayos, weather was a significant factor in survey execution. Areas found to be difficult nearly the entire time during Phase 1 surveys included the east, west, and northern sides of Piedra Stevens, Los Gemelos, and Alcarraza. The eastern sides of Culebrita and Cayo Geniqui, as well as the southeastern corner of Culebrita, were also nearly always rough, with typical wave heights on the order of 4 to 6 feet.

Future operations should be planned with the flexibility to take advantage of good weather to survey the difficult areas whenever possible and survey protected waters when no difficult areas remain. Rough waters make for difficult vessel handling and can also impact the accuracy of acoustic positioning systems. The vertical character of some of the shorelines also reflect the waves back offshore creating confused seas and sometimes dangerous conditions along the innermost transects of the exposed coasts.

3.6.2 Topography

The volcanic origins of Culebra and its surrounding Cayos created dramatic underwater features. The individual cayos often have steep slopes and large submerged boulders. These boulders can be seen in the video transect data. One such boulder off of the eastern side of Los Gemelos rises from 11 meters of depth to approximately 1.7 meters below the surface with an almost vertical face. This boulder was impacted by the camera system during Phase 1b video survey operations. The camera was being raised at the time but did not clear the rock. The camera mounting system hung on the rock and acted as a temporary anchor. The camera and mounting system were recovered without damage. The following day the impact area was inspected both with snorkelers and ROV and there were no signs of damage to any marine life. The rock is primarily covered in algae, with some sea fans and fire coral present. No listed species were harmed by the impact.

Future operations in the areas with large boulders and steep slopes will be surveyed using an ROV. The ROV has both cameras and an altimeter to constantly monitor its relationship with the seafloor therefore there is little chance of significant impact between the remote sensing equipment/ROV and the bottom in those areas.

3.6.3 Currents

Currents around the cayos can be strong at times. These will have a two-fold effect on future ROV operations. As the ROV equipped with EM has limited tether length (approximately 60 meters) it is necessary to keep the survey vessel close to the ROV while collecting data. Maintaining station on the vessel while surveying the transects will be difficult during periods of strong current. The currents also will increase wave height when the flow of the current is opposite the wind direction, resulting in rougher sea conditions. These waves tend to also have a shorter wavelength making them more hazardous.

Future operations need to be planned around currents in the most difficult areas, which include Alcarazza, Los Gemelos, and Cayos Geniqui and Tiburon.

3.6.4 Transect Orientation

During Phase 1A of the survey, no operations could be conducted with the survey vessel within 4 feet of the bottom. Therefore no SSS or multibeam data was available for 43 percent of MRS 07. Also, as benthic habitat type was not known, final survey methodology could not be confirmed. Snorkeling activities and satellite imagery allowed the necessary data to be gathered in those areas. Following snorkeling activities and benthic habitat determination, it was decided that the initial idealized transect layout should be modified for Phase 2 (EM Survey). This will allow for efficient surveying while minimizing risk to the environment. In areas where the EM float is proposed, transects will be re-oriented to follow bathymetric contours. Areas where the benthic sled will be deployed can still follow the pre-planned transects, with survey lines ended with sufficient distance to insure that neither the sled, tow cable, or survey vessel will come within 4 feet of corals. Areas to be surveyed with the ROV will still be surveyed along the pre-planned transects.

This space is intentionally left blank.

CHAPTER 4. PHASE 2 TRANSECT DESIGN

4.1 PHASE 2: UNDERWATER GEOPHYSICAL TRANSECT SURVEYS

As mentioned previously, Phase 2 field activities will consist of performing geophysical surveys along the revised RI transects established during Phase 1 (See Figures A-6 through A-10 in Appendix A). The objective of these activities will be to collect EM anomaly data resulting in the least amount of impact and still acquiring the highest quality data possible. The data collected during Phase1 will be used to plan out the Phase 2 technical approach. The U/W EM 61 geophysical coil will be deployed using three types of system platforms. As there is not one single EM system that is both highly efficient and can guarantee no environmental impact in all habitat types present in the areas surveyed, multiple platforms will be used to survey the designated areas. The system used in any given area will depend primarily on depth of water and type of habitat present. Based on analysis of all of the EBS data, Parsons/USA has assigned suggested EM platforms along each segment (as required) to each of the RI transects based on benthic habitat avoidance. Appendix A (Figures A-31 through A-43) includes the suggested EM platform deployments for the cayos of MRS 02 and MRS 07. Each EM platform shown on these figures are color coded. All of the cayos of MRS 02 will be surveyed using the EM ROV; there are no areas completely free of hard and soft corals with a bottom type suitable for the sled and water depths and expected sea conditions are not suitable for the float system.

4.1.1 EM Platform Selection Process

The U/W video and SSS data collected for each transect was reviewed by the RI team. While evaluating the SSS data and video of each of the transects, transect segments were designated an EM platform that would be best suited for the transect surveys during Phase 2. Consideration was given to the depth of water (bathymetry data), type of bottom (corals, sea grass, etc.) as interpolated from SSS data and validated by transect videos, and the anticipated sea state and the means in which the platform would be moved along segments of the transect. The start and stop points were also clearly identified by GPS coordinates to ensure the EM platforms are switched out at the correct points within the transect. Based on this analysis, maps were then generated depicting the proposed EM platform to be used for each RI transect segment (see Appendix A).

The following is a list of the EM platforms anticipated to be used during Phase 2:

- The EM sled is designed to keep the EM 61 coil as close to the sea floor as possible, to maximize the detection depth of buried MEC/UXO. The system can be towed across the sea floor on wheels or skids depending on bottom conditions. The sled can have a forward facing camera mounted on it with a real-time feed to the survey vessel.
- The EM ROV platform is used to propel the EM 61 coil along the RI transect. The ROV is equipped with a pressure sensor, altimeter, pitch sensor, roll sensor, and video cameras so real time monitoring of the coil is maintained under positive control by the ROV operator at all times; lending the ability to maneuver the ROV/EM coil around challenging bottom types (coral heads/ boulders). The EM coil is mounted in front of the ROV so it will be visible in the camera view at all times. Accurate positioning for the ROV and coil will be supplied by an ultra-short baseline (USBL) system set up between the survey vessel and the ROV system.
- EM Float platform suspends the EM 61 coil to a floating platform. The EM floating platform provides a means to float the EM coil in shallow waters along the bathymetric contour line. The EM float can be towed by a boat or pushed along by snorkelers. RTK-DGPS provides real time positioning by using the antenna mounted on the floating platform which is centered over the EM coil.

4.2 PHASE 3: INTRUSIVE INVESTIGATIONS AND ENVIRONMENTAL SAMPLING

4.2.1 Underwater Intrusive Investigations

It should be noted that specific methods for conducting follow-on U/W intrusive investigations as part of Phase 3 will be finalized during the TPP process. Phase 3 activities would most likely consist of U/W intrusive investigations of selected EM anomalies located along the RI (or EM) transects that were mapped as part of Phase 2. Parsons/USA anticipates utilizing UXO SCUBA divers (meeting DDESB TP-18 requirements) to perform intrusive investigations of these anomalies.

4.2.2 Environmental Sampling

To investigate the nature and extent of any MC contamination, the Parsons/USA investigation team will collect marine sediment samples. Analysis of the sampling data will involve a screening level risk assessment (SLRA) for human and ecological receptors. At present, Parsons/USA intends to only collect discrete marine sediment samples. Further DQOs will be developed through the TPP process to establish the actual data requirements. However it is anticipated that samples will be taken at locations where MD or suspected MPPEH items are observed. Parsons/USA does not anticipate sampling soft or hard corals, sea grass, or other species for the purposes of the SRLA.

Specific methods for collecting marine sediment samples will be finalized during the TPP process, however, Parsons/USA anticipates collecting samples using UXO SCUBA divers. Divers will utilize hand core samplers to collect marine sediment samples from locations not containing soft or hard corals, sea grass, or macro algae. All efforts will be made not to harm or harass species located directly adjacent to sample locations.

4.3 SUMMARY

Parsons/USA has evaluated the anticipated field activities, considered the potential impact on benthic habitats (including EFH and ESA), and determined the implementation measures needed to safely mitigate those impacts in order to obtain quality data required for the U/W RI/FS. The RI/FS project team will utilize the EBS information presented in this report during Phase 2 and Phase 3 TPP meetings in order to develop their respective DQOs and subsequent WPs.

Listed Threatened and Endangered Species will be a significant focus during the development of the Phase 2 and 3 Work Plans. The EBS data will provide validation for the "*SOP for Endangered Species and Conservation and Their Critical Habitat During Underwater Investigations at DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico*" or to identify changes or improvements as needed.

This space is intentionally left blank.

CHAPTER 5. REFERENCES

The following are references that may apply to the overall RI/FS project and EBS Report. Following their substantive requirements will ensure compliance with Section 121 of CERCLA and listed federal and local laws.

5.1 U.S. ARMY CORPS OF ENGINEERS GUIDANCE DOCUMENTS

- EM 200-1-4. Environmental Quality – Risk Assessment Handbook, 1999.
- EM 1110-1-1002. Engineering and Design – Survey Markers and Monumentation, 1990.
- EM 1110-1-4009. Engineering and Design – Military Munitions Response Actions, 2007.
- EM-1110-1-100 Engineering and Design – Conceptual Site Models for Ordnance and Explosives (OE) and Hazardous, Toxic, and Radioactive Wastes (HTRW) Projects, 2003.
- EM 385-1-97 Explosives Safety and Health Requirements Manual
- EM 385-1-1. Safety and Health Requirements Manual, 2008.
- ER 200-3-1. Environmental Quality – Formerly Used Defense Sites (FUDS) Program Policy, 2004.
- ER 385-1-92. Safety - Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW) Activities, 2007.
- ER 1110-1-12. Engineering and Design – Quality Management, 2006.
- EP 1110-1-18. Military Munitions Response Process, 2006.
- EP 1110-3-8. Engineering and Design – Public Participation in the Defense Environmental Restoration Program (DERP) for Formerly Used Defense Sites (FUDS), 2004.
- EP 1110-1-24. Establishing and Maintaining Institutional Controls for Ordnance and Explosives Projects, 2000.
- USACE Standard Operating Procedure for Endangered Species and Conservation and Their Critical Habitat During Underwater Investigations at DERP-FUDS Property No. I02PR0068, Culebra Island, Puerto Rico (April 2012)

5.2 U.S. ARMY DOCUMENTS

- Army MMRP, Remedial Investigation / Feasibility Study Guidance, 2009.
- TM 60A 1-1-31, Explosive Ordnance Disposal Procedures, 1994.
- AR 385-64, Ammunition and Explosives Safety Standards, 1999.
- AR 190-11, Physical Security of Arms, Ammunition and Explosives, 2006.

5.3 DEPARTMENT OF DEFENSE DOCUMENTS

- DOD 6055.9-M, Ammunition and Explosive Safety Standards
- DOD 4145.26-M, Contractor's Safety Manual for Ammunition and Explosives
- DDESB TP-18, Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel

5.4 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

Occupational Safety and Health Administration (OSHA) 1994 ***General Industry Standards***, 29 CFR 1910 and ***Construction Industry Standards***, 29 CFR 1926; especially 1910.120/29CFR 1926.65-***Hazardous Waste Site Operations and Emergency Response***.

5.5 U.S. ENVIRONMENTAL PROTECTION AGENCY

Risk Assessment Guidance for Superfund (RAGS), 1989.

5.6 FEDERAL REGULATION

- Code of Federal Regulations (CFR)
  - 33 CFR 320 Wetlands Protection Act
  - 40 CFR 300.430 National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 1993.
  - 40 CFR Part 261.23 Resource Conservation and Recovery Act.
  - 49 CFR Parts 100-199 Transportation.
  - 62 Federal Register 6622, 1997 Military Munitions Rule.
- Fish and Wildlife Coordination Act 16 U.S.C. 661 et seq.
- Endangered Species Act 16 U.S.C. 1531-154.
- Migratory Bird Treaty Act 16 U.S.C. 703-712.
- National Historic Preservation Act 16 U.S.C. 1470.
- Clean Water Act 33 U.S.C. 1151 et seq., 1251 et seq., 40 U.S.C. 3906 et seq.
- Comprehensive Environmental Response, Compensation, and Liability Act 42 U.S.C. 9601-11050.
- U.S. Fish & Wildlife Service, Culebra National Wildlife Refuge, undated.

5.7 COMMONWEALTH OF PUERTO RICO REGULATIONS

- Law 147 of 1999 (Act for the Protection, Conservation and Management of the Coral Reefs in Puerto Rico)
- Law 241 of 1999 (New Wildlife Law)
- Law 278 of 1998 (Puerto Rico Fisheries Law)
- Regulation 2577 (Regulation to Control the Extraction, Possession, Transportation and/or Sale of Live or Dead Coral)

5.8 OTHER DOCUMENTATION/SURVEYS AND STUDIES FOR THE EBS REPORT

- Kendall, M.S.1, M.E. Monaco1, K.R. Buja1, J.D. Christensen1, C.R. Kruer2, and M. Finkbeiner3, R.A. Warner1. 2001. (On-line). Methods Used to Map the Benthic Habitats of Puerto Rico and the U.S. Virgin Islands URL: http://biogeo.nos.noaa.gov/projects/mapping/caribbean/startup.htm. Also available on U.S. National Oceanic and Atmospheric Administration. National Ocean Service, National Centers for Coastal Ocean Science Biogeography Program. 2001. (CD-ROM).Benthic Habitats of Puerto Rico and the U.S. Virgin Islands. Silver Spring, MD: National Oceanic and Atmospheric Administration.
  - NOAA National Ocean Service, Biogeography Branch; N/SCI 1, SSMC4; 1305 East West Highway; Silver Spring, MD 20910
  - NOAA Coastal Services Center, 2234 South Hobson Avenue; Charleston, SC 29405